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Practical Mathematics.

We have before now noticed in terms of approval some of Professor John Perry's books, among which are his "Applied Mechanics" and "Calculus for Engineers," and we have before us a pamphlet of his, entitled "Practical Mathematics," which is a revision of six lectures to working men, and is published by the Department of Science and Art of the Committee of the London Council on Education.

Professor Perry is connected with the Royal College of Science at South Kensington, where he has attained a national reputation as a successful teacher of mathematics, and his methods are attracting a good deal of attention in England.

This pamphlet is perhaps the best, because, space considered, it is the most comprehensive exposition of his methods. To the orthodox mathematician he appears as an absolute iconoclast, and in point of fact he appears to have no respect whatever for tradition. Thus he would suppress much of the geometry of Euclid entirely, holding that much of it is self-evident and that much more of it can be treated in far simpler ways by algebra. He considers that the methods which prevail in the teaching of geometry result from mere blind adherence to tradition. In Euclid's time, algebra, and even arithmetic, were very imperfectly understood, and in fact he accuses Euclid of having been "hopelessly ignorant of arithmetic," and to this he attributes many of his methods. These he would now discard.

The key to his general plans lies in the fact that he teaches mathematics as an art and not as a science. He has no regard for what others would call the "symmetrical development of a great subject," and has very little use for the discussion of abstract questions. He regards mathematics as a tool to be used, and not as a science to be studied for its own sake, and he bends his energies as a teacher to making his students proficient in handling this tool. In this way he omits much that is ordinarily included for its supposed disciplinary value, or because the "symmetrical development of the subject demands it," regardless of its utility, and on the other hand he includes much on such subjects as the analysis of observations which does not find a place in ordinary mathematical text books at all, because it is "applied" and not "pure" mathematics. Following this general line of treatment, Professor Perry's work, both in this pamphlet and in the more formal treatises, bristles with concrete illustrations and examples, and he insists on the student performing a large number of computations. Without this, he tells us, "it is as useless to read minute instructions as it is to try to learn to swim or ride a bicycle by reading instructions."

It is perfectly clear to us that there is a great field for mathematical teaching of this kind. The forgetting of his mathematics is the commonest experience of the engineering graduate, and this we believe to be mainly due to the fact that it is so largely studied as an abstract science. This is not much helped by the applications found in applied mechanics and physics, because these studies are pursued in much the same spirit. The term applied mechanics as given to the course of study bearing that name is in fact a misnomer. It is almost as abstract as pure methematics; its methods are purely *a priori*, and the subject should properly be called pure mechanics, the word pure being used in a sense similar to that in pure mathematics.

While this pamphlet comprises but 127 pages, it covers an astonishing amount of ground, and includes many problems that are by no means elementary. These the author solves in many cases by methods that would make the cold shivers run down the backs of most teachers of mathematics; but the point is, he solves them. This in his mind, and in our own, is sufficient justification of his methods. The methods are nothing; the result is everything.

It is but proper to add that we are by no means convinced that the novice will be able to read this pamphlet successfullv without help. The author's language is extremely compact, and he relies very largely on the intuition of his students to supply proofs or to dispense with them.

Thus after a very brief explanation of the slide rule, he says: "Think it out for yourself; practice multiplying simple numbers; ask nobody to help you and you will rapidly get familiar with and fond of the slide rule"; and again he says, "But instructions are of no use. Find all this out for yourself." Whether the beginner can read the pamphlet or not, however, does not alter the fact that it discloses what must become the method of presenting its subject to engineering students. The utility of mathematics to the engineer forms the only tenable argument for mathematical work in engineering courses of study. Except it be useful, the study has no more place there than Greek or Chinese, and its presentation, divorced from its applications and as a subject studied largely as a science for its own sake, must give way. The pressure due to lack of time will eventually compel this, even if the merits of the newer way do not find immediate recognition.

The nearest approach to the spirit of Professor Perry's methods that we have in this country is found in the work of the correspondence schools. The sheer pressure of necessity compelled this course with them, though possibly the fact that those schools are under the direction of engineers rather than professional teachers may in a large measure have led to the course adopted, just as the fact that Professor Perry is an engineer rather than a mathematician, has led him to present the subject from the standpoint of the engin-

eer's needs rather than from that of the mathematician's ideals.

Until Professor Perry commenced his work there was probably no instance in which a course in mathematics for engineering students had been conducted by an engineer. It has been assumed as a matter of course that the mathematical teaching should be done by mathematicians, and as a natural consequence the work laid out by them has had no special adaptation to their students' needs. Much useless ground has been covered and, meanwhile, not only have the applications of the subject to engineering problems been slighted, but the necessary drill in such applications has been almost ignored. The subject, consequently, has not, except in a few exceptional cases, become a part of the students' mental equipment, in the sense that his multiplication table is part of that equipment, and while he may be able to read the work of others he has little independent command of the subject. Is it not just possible that herein lies the secret of the aversion of so many to mathematics and of the common belief that it is of little value? We very much believe that this is the case, and that there is need for some one to take up Professor Perry's work in this country.

Electrical Puerility.

It would really seem that electricity is now sufficiently established in universal use, so sure of appreciation and of constantly increasing and widening employment, for the perfunctory guardians of its supposed interests to be able to relent a little in their childishly jealous and critically querulous, if not quarrelsome, attitude towards all who ever feel impelled to say a word concerning it and all its relations other than in direct and positive commendation. Electricity is not now, and will never be, in the slightest danger from any truths or any untruths that may be spoken concerning it, nor from any supposedly injudicious or disproportionate insistence upon any phases of its relations to the world in general.

The recent disastrous explosion in, or, rather, of a large chemical warehouse in our city, resulting in its complete destruction, with also that of a score of contiguous buildings, the shattering and demoralization of many others and the loss of a considerable number of lives, of course demanded extensive remark, both from the daily papers and many of the technical journals. The explosion, although succeeded by a conflagration of such magnitude as is of unfrequent occurrence, was preceded and caused by a fire such as the fire department is almost daily called to extinguish, and this fire is supposed to have been caused by the electric wires in the building. This, of course, opened the way for the saying of various things concerning the dangers from improperly arranged and from carelessly deranged electric wires. This seemed to be a very fitting time for enforcing a still needed lesson, and it is not to be wondered at that the opportunity was to some extent availed of.

It happened that only a few days after the explosion of which we have been speaking there occurred another in which the front of a single building was blown out, with perhaps one-fiftieth of the pecuniary loss sustained in the former case and with no loss of life. This latter explosion was unquestionably caused by gas, and electricity had nothing to do with it. It was frankly stated that gas caused the explosion, and as the dangers from gas are well known, and the conditions of safety also, there was little need of saying anything, and there was little said, about the damage and destruction of which gas has been and may be the cause. Nevertheless there are those who do not hesitate to make complaint because there was not as much denunciation of gas in the one case as of electricity in the other. As we understood it, there was no denunciation of either, and it does not seem to be claimed that untruth and error were maliciously promulgated concerning electricity, only it is somewhat whiningly suggested that there was some unfairness in telling the truth more voluminously about electricity than about gas. It may be urged that gas has been catching it for half a century, while we have had only a decade of electricity. It may be claimed that it was a friendly interest in electricity, rather than anything inimical, which prompted the enforcement of the lesson of danger when the danger so emphatically asserted itself. If those who claim to labor with all their might for the advancement of every interest of electricity had so persistently spoken of the danger of it under certain conditions as to have induced caution and watchfulness sufficient to have prevented the catastrophe which occurred, they would have been truer friends of electricity than under the circumstances they have actually proved themselves to be, although this is not saying that they may not have done all the warning and all of the showing of correct practice that might reasonably be expected of them.

Armor Plate Prices and Competition

The announcement that the government and the two concerns that make armor plate have agreed upon a price of $420 per ton for 24,950 tons of Krupp armor plate illustrates again the fact that no trust, combination or agreement between manufacturers can enable them to demand and get what they choose to ask for a product when they do not control the supply of raw materials nor the lines of transportation by which materials and product must be shipped. Bids for armor plate, gun forgings, etc., have been repeatedly submitted that were at precisely the same figures from Carnegie and Bethlehem. There is no more wrong in this, so far as we can see, than for two machinists to both demand the same rate of wages at the same time; but when the machinists make their demand they do it in competition—whether consciously so or not—with all other machinists, abroad as well as at home, and in the case of the armor-plate prices the manufacturers found they were really in competition with a plant not yet constructed but which had been authorized by Congress in case satisfactory prices could not be obtained and on which John Fritz had done considerable work of a preliminary nature. The result is a contract at a price that must be considered fair. The outcome of pending litigation as to royalties makes the government liable—by agreement—for an additional $35 per ton.

Child Labor in Southern Cotton Mills.

There is a movement on foot to restrict child labor in factories of Georgia (as there ought to have been before this), and we note that among the arguments urged against the proposed legislation is the claim that New England cotton-mill owners are working for it. Whether they are or not does not in the least effect the righteousness of the proposed law, and we should say that if the New Egland cotton-mill men are really working for such legislation in Georgia, it is simply one of these not infrequent cases wherein private interests coincide with the public welfare. The employment of children of tender years in factories when they should be at school, at home, or at play, is an outrage upon humanity, and is bound to work harm to the race that permits it. The cotton-mill owners of Massachusetts could not secure the repeal of similar laws in their own State, because the laws are plainly seen to be in the public interest. If then they are driven to work for the enactment of such laws in States where there are competing cotton mills, it is fortunate that there is thus enlisted a strong private interest on the side of humanity and decent conditions of existence.

The editor of the "Monthly Journal of the International Association of Machinists" thinks we do wrong by noticing in our columns the Machine Trade and Professions Association, of Columbus, Ohio. No doubt the editor is entirely sincere in that belief, but the "American Machinist" has always been in the habit of printing the news that pertains to the art and business of machine construction. When we first learned of the organization of the International Association of Machinists, we printed the facts regarding its organization because we conceived it to be our duty to do so. We did not stop to inquire as to the character or the probable intentions of its founders, but left all that for the future to develop. We did the

same in respect to this new organization, and if we should hear of still another organization to-morrow, we should consider it our duty to make our readers acquainted with the facts regarding it, so far as they might appear and seem to be pertinent. Our position is, that the mere fact of organizing is not a crime nor an offence, and that organizations, like individuals, must be judged by their works. If they do wrong, their wrong-doing must be condemned, and if they do right, they must be credited with doing it. An organization which tends to get employers and employees together to calmly discuss matters pertaining to the business is, it seems to us, capable of doing a great deal of good. For various reasons it may fail to do any good, but it certainly would be very unfair for the "American Machinist" to decide beforehand that it cannot do so. We think it better to at least hope that it will do good, and to assume that it will, until there is evidence to the contrary.

The Manufacturers' Association of New York, 198 Montague street, Brooklyn, has appropriated $2,000 for a scholarship to give a young man of New York four years' industrial education.

Commercial Review.

NEW YORK, Saturday, November 17.

THE MACHINERY AND SUPPLY MARKET.

Some inquiries were made this week of machinists' supply agents and the dealers, and the replies indicate that while there is a better feeling in that branch of the market and trade is fairly good, there has been no especial boom since election.

It is now so near inventory time that most consumers who did not assume the risk of placing stock orders before election will be disposed to keep along till after the first of the year on purchases for immediate necessities only. Prices are advancing on some lines, such as machine bolts.

The long drawn-out transactions incident to the acquisition of control in the Pratt & Whitney Company by the Niles-Bement-Pond Company are virtually consummated. The former company has taken out a new charter under New Jersey laws with $2,750,000 capital, of which $1,225,000 will be a 6 per cent. cumulative preferred stock and $1,525,000 common stock. The "principal office" of the new concern is nominally at the Corporation Trust Company building in Jersey City. The incorporators named are: K. K. McLaren, Clifford W. Perkins and Mark M. Salmon.

The E. P. Allis Company, it is understood, is to make a move which will set a lively pace for its rivals, and which by the laws of business competition ought to be a powerful stimulant to new engine-shop equipment. The company's works at Milwaukee have long been notoriously crowded with orders, and although it has taken outside shops and recently had work under way in seven different plants, many contracts have had to be passed by. Enlarged facilities in Milwaukee were being arranged for, but the project now announced is to stop improvements there and to erect a big new plant outside the city. Reports of the plans drawn up for the new works state that these will be built on a site of 80 or 100 acres, that $2,000,000 will be spent on the buildings exclusive of equipment and that 4,000 men will eventually be employed. Waukesha people are making efforts to have the plant located there. The October sales of the Allis Company were up to the average. Orders were received from Texas, North Carolina, Colorado, Georgia, Florida, Louisiana, Indiana, Washington State, Kansas, New York, Ohio, British Columbia, Idaho, Mexico, and Chile. The Chilian order was for a large quantity of flour-mill machinery. Officers of the company say that the outlook for business is excellent.

The Northern Pacific Railroad Company will build new shops at Brainerd, Minn., the steel work of which will be furnished by the American Bridge Company.

MORE EVIDENCE ON THE EUROPEAN TOOL MARKET.

Henry J. Hendey, president of the Hendey Machine Company, Torrington, Conn., returned November 10 from a two-months' trip abroad, his time being spent principally in London and Paris with a flying trip through Brussels and Cologne, to Frankfort and Berlin. By request, Mr. Hendey has written us as to his conclusions upon European trade, which are as follows:

"While business conditions abroad are not in as satisfactory a condition as in the past, we have reason to believe we will have considerable business despite the vast amount of copying of our machines, of which copies we found a great many in the Exposition. Our trade in Great Britain is very good, and in France we believe after the Exposition is out of the way there will be a better trade. There is nothing we can add to what has been said in your paper from week to week, and we fully agree with same."

Among the fall arrivals from the other side is a man who manages the machinery department of a local export house through which not a few of our tool builders conduct their foreign trade. He had been spending several months on the Continent. Speaking to a representative of this paper he said in effect:

"Among the interviews which you have recently published, that with Mr. Binsse printed in No. 44 seems to me to express the situation most accurately and fully. I met that gentleman in Cologne, and we talked over matters, our views agreeing almost entirely.

"Speaking for myself, I would say that German demand for American tools has dropped off almost completely. It will probably revive, but not very soon. The vital question aroused by the German tool-copying movement is: 'Can a dollar be made to go farthest by spending it in Germany or in America?' The answer to that question will depend in part upon the results accomplished by Ludwig Loewe & Co., when they get into full swing. They have a plant for which expense has not been spared to procure the best equipment obtainable. I cannot speak definitely of the character of their output as compared with American tools, nor of their prices. The product of most German manufacturers I have certainly found to contrast unfavorably with the American. Are our tools worth the difference in cost? I think they are. The copies of them fall short of the originals in details. At a little distance off they could hardly be told apart, but on closer inspection the inferiority of the German-built machine appears. This is true not only of pirated tools, but in a case I heard of where the manufacture was authorized. An American firm who build a special turret lathe have sold or leased their French and German rights. A buyer who had used one of their own make and later one of the same as built abroad—in Germany, I think—became dissatisfied with the latter and was anxious to get an original when he had occasion to purchase one again. There is a perceptible disposition, however, on the part of the Germans to buy home-made goods, and when the domestic copies of foreign tools are a fairly good approximation of the originals they are likely to be given the preference.

"The French demand for American tools has been interfered with by the Exposition, but there is a prospect of an improvement now that it is over. I think the French have learned from the fair how far the Germans are ahead of them industrially and that they will be stimulated to renewed efforts. Americans are not viewed with much favor in France. They are regarded as Shylocks, and their statements are distrusted. But I do not know that there is any more love for the Germans. I heard a rumor that a concern is to be started in France for the imitation of American tools of which, as far as I know, little if anything has yet been done in that country. One of the French stores formerly devoted to the sale of American tools is now turning its attention to German-built machines, but it is not one of the largest houses of its class.

"I spent hardly any time in England, but am of the opinion that our most promising market at present is in that country."

Good authorities believe that Loewe's tools rank high, and since it is stated that they can be bought by consumers as low as American tools can be purchased by a dealer, laid down in Germany, it would look as if the manufacturers on this side were at a disadvantage. Reinecker's tools are first class, but they are largely of a special nature and therefore are not so

notably a factor of competition with our regular lines.

Evidently if many more standard American tools are sold in Germany, their makers will have to sacrifice profits. Symptoms of a tendency to accept lower figures are found in the report that some of our very largest tool builders are considering the advisability of making reductions officially. Other builders having plenty of work are not disposed to make concessions.

In view of the generally depressing reports of Continental demand, it is encouraging to note that one of our manufacturers of small machine tools, including upright drills and foot-power lathes, reports an excellent export trade, and even the recent German orders are holding their own. The active demand for this class of goods in England, however, seems to have shifted over to France, from which country good orders are being received as a result of the Exposition, apparently. The demand on the Continent is rather for drills than for foot-power lathes, the latter having the preference generally elsewhere. In China and Japan, there is a demand for both, while recently in India requirements are getting to be for the drills. A new country first turns its attention to woodworking machinery and afterwards a lathe demand is created.

The North German Lloyd Steamship Company is to build on the banks of the River Weser, at Bremen, a two-story machine shop, 100x300 feet, and a foundry about 75x600 feet. These buildings are designed after the best American practice and the contract for the structural steel has been awarded to the American Bridge Company in competition with the best German shops. There is every reason to hope therefore that American tool builders will supply the shop equipment.

CHICAGO MACHINERY MARKET.

The Chicago office of one engine builder has received during the past ten days inquiries for engines to the value of $2,500,000. Among these inquiries were those for twenty-two engines of 5,000 horsepower each, developed at point of greatest efficiency. They came from four different street railway companies and chanced to be for a common type of product. They constituted the bulk of the inquiry and this one report of trade is a fair index of what the demand is in its entirety. Since the election there has been a loosening up of trade, but it has been mainly for the larger units and mainly for electrical work, of which there is in prospect no end, seemingly.

For shops and factories, the present call for power is somewhat more uncertain. A fair business is reported, somewhat after the order of the past six months, the change, if any, being in the direction of improvement. One new shop of large capacity has been arranged for definitely, but details for publication are for the present being withheld. Deliveries of both boilers and engines of large capacity cannot be obtained under several months, some makers being sold up for a considerably longer time. It is pointed out by representatives of several large producing companies that buyers are not unlikely to make the same mistake in ordering power that they did a year ago, by deferring the orders too long. One remarks that he recently suggested to the owner of a new plant already under cover the propriety of arranging for the necessary power for use next spring. The reply of the buyer was that he would wait until about sixty days before he wanted the machinery. If the trade expected within the next several months is realized, the last buyer to close for his needs will fare badly in deliveries. Some sellers are of the opinion that general buying for next year's requirements will be deferred until after January 1. Nevertheless the actual sales during the first half of November have exceeded those of any similar period this year by a good round margin. While there is no marked change in values the tendency is upward, partly in consequence of advancing material.

The Chicago office of the Babcock & Wilcox Company did a business during the first half of November equal to that of the entire month of October, which was decidedly the best month of the year to date.

Among orders of the Buckeye Engine Company was one from the Muscatine (Ia.) Street Railway Company for one 200 and one 400 horse-power cross compound engine.

CINCINNATI REPORT.

Notwithstanding the apparent improvements in prospects with machinery and machine tool-making concerns generally since the election, there is not really that marked increase visible that many would think the conditions justify. Yet a number of the larger milling machine companies note a disposition to place stock orders and an increase in inquiries from all parts of the country. One or two of the smaller concerns are closed down temporarily.

William E. Gang & Co.. making machine tools, will close down for two weeks beginning November 19, for a series of improvements throughout their establishment. They will put in a new stock room and several minor departments.

The Cincinnati Machine Tool Company reports business fair with plenty of inquiry relating principally to some large deals in the East.

Local makers of machinery feel the general advance in material, especially marked in pig iron and structural steel. It is generally believed that the furnace and mill men were too high, and that this is to blame in a great measure for the recent slump. Confidence is now restored and business is expected to come down to a steady basis soon.

A consensus of opinion from manufacturers in the lines of medium and larger-sized tools indicates that the prices on material are becoming a little stiffer, but with no indications of any great advance on the finished product. The idea seems to be that those houses which found it necessary to reduce prices during times of depression will now have to increase, which move will of course bring with it attendant difficulties.

The S. Obermeyer Company, foundry and mill supplies, one of the largest concerns of its kind in this country, reports the largest business this year of their history. Among other orders two good ones just received are from Valparaiso, Chile, and London, Eng. An official of this firm in discussing some late orders mentions a lot of work for a concern in Alliance, Ohio, including a 15 and a 20-ton ladle, which are supposed to be the largest turned out.

The I. & E. Greenwald Company, general machinery, reports prospects good with a vast amount of inquiry from the South for irrigating machinery. Much of this comes from Texas. Indications point to the placing of large orders in these lines in December.

The Lunkenheimer Company, manufacturers of brass goods, note an increase in orders, especially for brass valves. This company furnishes considerable manufactured product for the government.

Quotations.

NEW YORK, Monday, Nov. 19, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$17 00 @ $17 50
No. 2 X foundry	16 00 @ 16 50
No. 2 plain	15 00 @ 15 50
Gray forge	14 50 @ 15 00

Alabama Irons:

No. 1 foundry, or soft	15 25 @ 16 25
No. 2 foundry, or soft	14 50 @ 15 00
No. 3 foundry	14 00 @ 14 50
Foundry forge, or No. 4	13 50 @ 14 00

Bar Iron—Base size—For good refined brands on dock, 1.40c. upward, and for same from store, 1.70c. @ 1.80c., in an ordinary way.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery steel — Base sizes — From store, 1.70 @ 1.75c.

Cold Rolled Steel Shafting—Base sizes —From store, 2½c.

Copper—Lake Superior, ingot in carloads, 16⅞ @ 17c.; electrolytic, 16⅝ @ 16¾c.; casting, 16½ @ 16⅝c.

Pig Tin—28¾ @ 28⅞c. for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—Prime Western, 4.35c., New York delivery.

Antimony—Cookson's, 10½ @ 10¼c., according to quantity; Hallett's, 9¼c.; United States, 9.10 @ 9.35c.

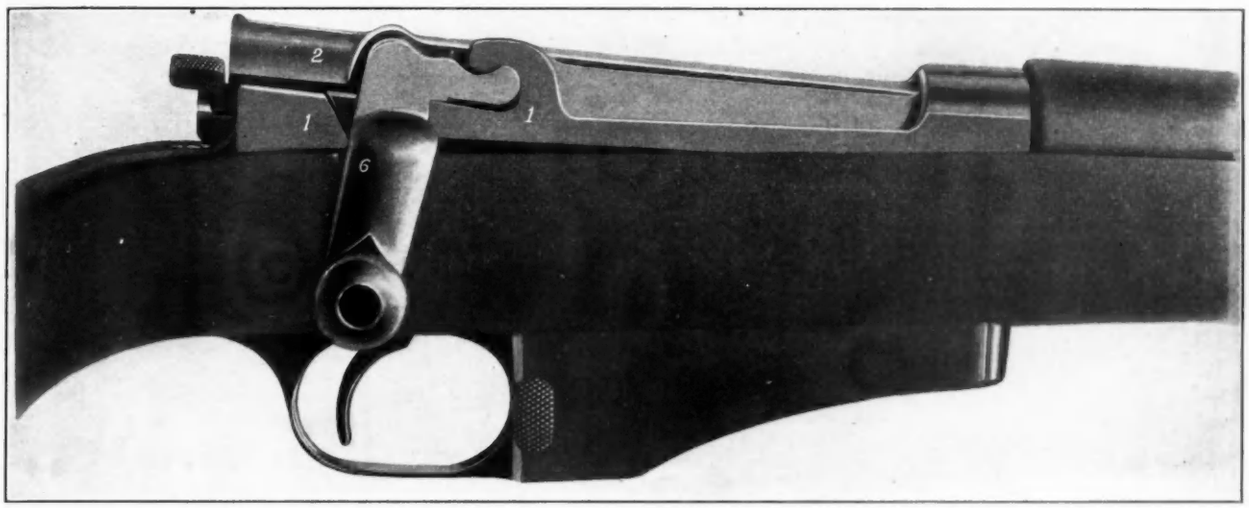


FIG. 1. RIGHT-HAND SIDE OF 1895 MODEL, SHOWING CAM LEVER; BOLT CLOSED.

The Lee Straight-Pull Magazine Rifle.

BY E. G. PARKHURST.

Over forty years have elapsed since the veteran inventor, James P. Lee, commenced his life-work of perfecting firearms of the shoulder type. Among his many inventions is that of locating the magazine in front of the trigger guard, which has been so universally copied, and is now in use by England, Germany, Austria and many other powers.

About twenty-four or twenty-five years ago Mr. Lee conceived the idea of the straight-pull system. In order that the reader may clearly understand the meaning of the term "straight pull," it should be first understood that the major portion of the arms now in use, having a breech closure of the bolt system, are known as turn bolts, because the bolt is locked by a partial rotary motion. In order to insert the cartridge into the chamber of the barrel, two distinct motions are required—first, a forward movement with the hand and elbow, in a straight line; second, a rotary motion of about 90 degrees to lock the bolt, and at the same time close in the cartridge ready to fire, after which the same motions, in reverse order, unlock, extract and eject the empty shell or case. In the straight-pull system only a forward and backward straight-line movement is required.

HOW AND WHY THE LEE GUN WAS ADOPTED BY THE UNITED STATES NAVY DEPARTMENT.

In the year 1894 the United States Navy Department came to the conclusion that the shoulder arm then in use (though a Lee magazine loader, turn-bolt system) was not in keeping with the advance of science. That such a conclusion was reached was largely due to the efforts of two naval inspectors of small arms, one of whom began to agitate the subject early in 1891, and was ably seconded by the other in 1892, they, together, acting through the then Chief of Naval Ordnance, an expert in many sciences. It may be said that it is well nigh impossible to overestimate the service this distinguished officer rendered the department during his term of office. It was he who brought the matter to the attention of the Secretary of the Navy, who duly appointed a board of very much alive officers, having advanced ideas concerning the requirements of shoulder arms. Among the number were experts who had thoroughly investigated the subject and made themselves acquainted with all the then known systems, and who therefore knew what an arm should and should not do. This committee invited all, both foreign and native, inventors to submit their systems to a competitive trial. Among the many who responded to the invitation was Mr. Lee, who submitted his then new straight-pull gun.

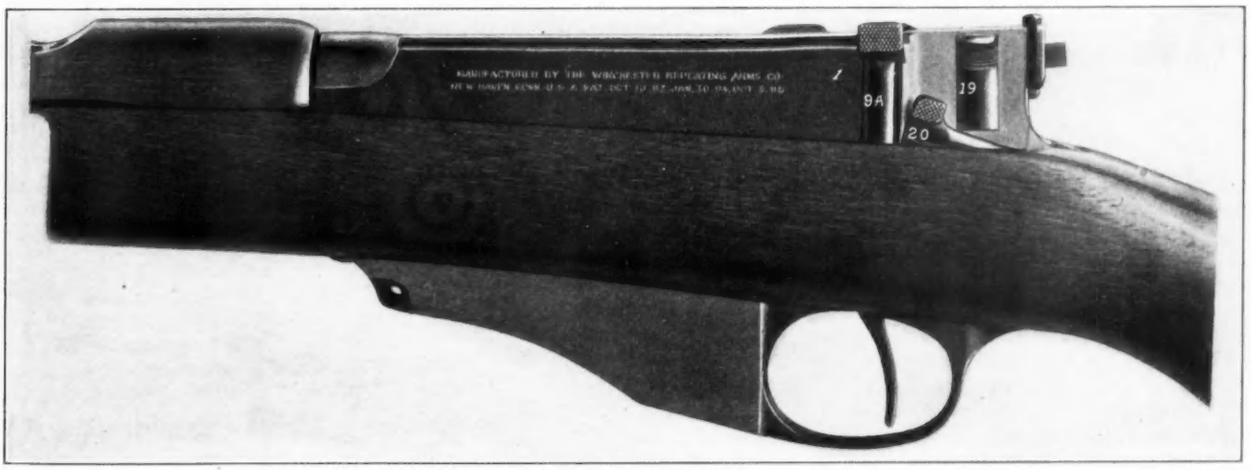


FIG. 2. LEFT-HAND SIDE OF 1895 MODEL, SHOWING BOLT STOP, BOLT RELEASE AND FIRING PIN LOCK; BOLT CLOSED.

None of the many guns entered came up to the high standard set by the board, though after a series of trials and carefully conducted experiments, they discovered the elements of success largely made manifest in the Lee straight-pull system. As it came somewhere near their ideal arm, and because of its rapid fire, easy action and wholesale loading from light-

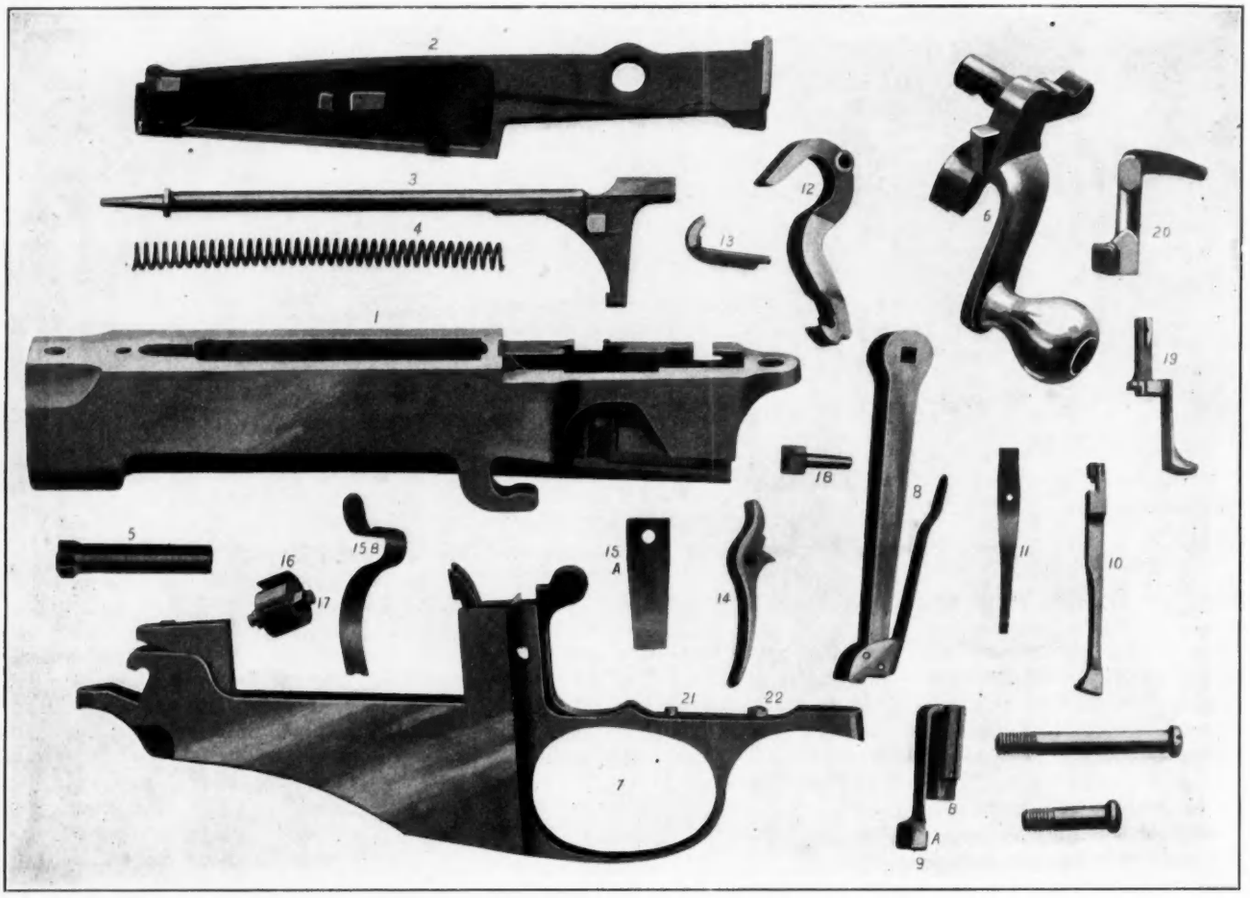


FIG. 3. PARTS OF THE 1895 MODEL.

weight loading clips, they recommended its adoption for the naval service.

CRITICISMS OF THE OPPONENTS OF THE LEE SYSTEM FOR MILITARY SERVICE.

I trust I may be pardoned for touching on a topic which might be considered foreign to the subject matter. There have been, and always will be, opponents of any new system of military arm, and many opinions will be given as to their adaptability for service, even by those who never have handled a gun for business. The story told of General Winfield Scott's adherence to the flint lock, loading and firing in twelve motions, and stoutly opposing the introduction of the percussion system for the United States musket, may be told again as an example of how men having sound ideas on most ordnance affairs can go wildly astray on matters of genuine improvement, particularly when such ideas do not emanate from themselves. Even at this day there are those who oppose the theory of rapid fire and quick loading and advocate single breech loaders, their potent reason being that "it is a waste of ammunition." The man behind the gun has totally destroyed this theory, and in practice he loads the magazine of his gun as quickly as possible, and fires the same at word of command or when he is good and ready.

The only criticism having the least possible weight against the gun was the small caliber, 7 m/m, instead of the .39 inch, which was at that time in use by the army. This matter cannot be called altogether a mistake, when considered from a scientific standpoint, as flat trajectory, deep penetration and light-weight ammunition are subjects worthy of more than

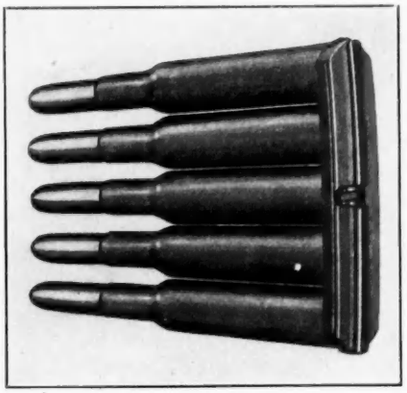


FIG. 4. LOADING CLIP, 1895 MODEL.

passing consideration, though it may be said that the greatest good for the greatest number would have involved uniform ammunition for all branches of the service.

ADVANTAGE CLAIMED FOR THE STRAIGHT-PULL SYSTEM.

The forward and backward motion of the bolt action in the straight-pull gun is both quicker and easier than the two distinct movements in a turn-bolt arm. It should be remembered that in all turn-bolt systems the latter portion of the partial rotary action is utilized, through a wedge cam action, to start the fired cartridge case from the chamber in the barrel. Should the case stick (and stick they will, more particularly after the parts become heated), much force has to be applied to the handle of the bolt, which brings up against one side of the straight-line path in the receiver; resulting in undue friction. It should also be remembered that it requires about 60 per cent. of the rotary action to unlock the bolt, therefore only 40 per cent. is left for starting the case, and against a steep wedge cam, making almost a dead lock. A blow of the hand on the bolt handle is often required, and at such times the extractor is quite liable to slip out of the cannelure or over the head, as the case may be, of the shell. Such happenings have occurred, and continuous firing generates heat, which increases the trouble.

The breech mechanism and the surrounding parts of the gun as first made—now known as the 1895 model—are shown in Figs. 1 and 2, and the separate parts in Fig. 3, the reference numbers of the corresponding parts being alike in the different illustrations.

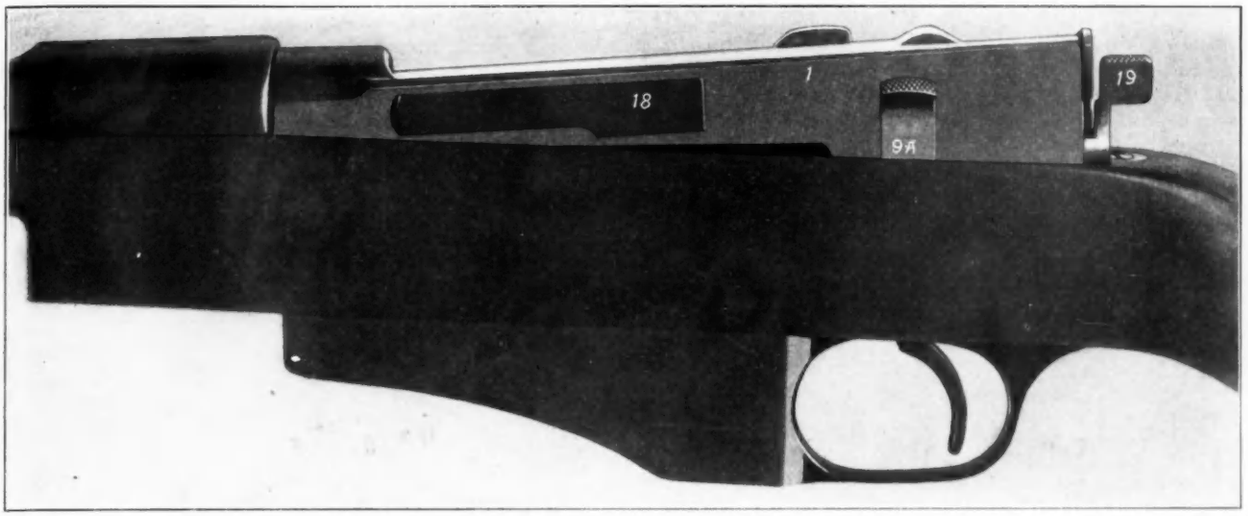


FIG. 5. LEFT-HAND SIDE OF 1899 MODEL, SHOWING BOLT STOP AND SAFETY LOCK; BOLT CLOSED.

UNLOCKING THE BOLT.

The unlocking of the bolt is accomplished by drawing back the handle of the lifting cam 6, clearly shown in Figs. 1 and 3. The receiver 1, Figs. 1, 2 and 3, carries the bolt 2, to which the lifting cam 6 is pivoted and with which it travels. When the cam is drawn to the rear, its first action is to lift the bolt from its abutment in the receiver, clearly shown in Fig. 1, after which a continuation of the movement draws the bolt to the rear until it is arrested by the bolt stop 9, Figs. 2 and 3, which also controls the ejection. This is very easy.

THE EXTRACTOR.

The extractor 10, Fig. 3, operates on an entirely different principle from that employed in the turn-bolt system. In fact, the extractor serves in three capacities—extraction, ejection, and as a stop for retaining the cartridges after they are placed in the magazine. The extraction is accomplished by a blow. As the bolt is allowed a backward run of about 1¾ inches before the lug on its head reaches a corresponding lug on the top of the extractor, it will be seen that a blow can be delivered on the cartridge shell by the bolt and its attachments. Experience has demonstrated that a slight sharp blow is what is wanted to start a sticking shell from a hot chamber.

OTHER ADVANTAGES.

In this gun all the shots in the magazine can be easily and quickly fired without taking the arm from the shoulder, and there is but little danger of disturbing the aim. Therefore less vital energy is required than in the turn-bolt arm, which is usually raised and lowered from the shoulder after each discharge. Should a soldier fire 50 shots from a turn-bolt gun (the weight of the gun being about 10 lbs.) 500 lbs. would have been handled, and probably the amount of muscular force required would be doubled in consequence of removing the arm from the shoulder. There are no screws in the working parts, and the Lee gun can therefore be dismantled and put together again with the fingers alone.

The 1895 model is essentially a rapid-fire or repeating-arm rather than a magazine gun, since there is no provision for cutting off the supply of ammunition from the magazine and using the arm as a single loader while the magazine contains cartridges. It may be used as a single loader if the magazine be not charged, but in general it is to be used as a repeater, five cartridges in a clip being entered in the magazine and the gun not being reloaded until this charge is exhausted. In case loose ammunition is furnished, the magazine may be charged with cartridges in any number from one to five. The weight of the gun complete, inclusive of the sling and knife bayonet, is 9 pounds 7 ounces.

FIG. 6. RIGHT-HAND SIDE OF 1899 MODEL, SHOWING CAM LEVER, SAFETY LOCK AND MAGAZINE CUT-OFF; BOLT CLOSED.

THE LOADING CLIP.

The loading clip with its five cartridges is shown in Fig. 4. It consists of two parts—the body and the locking lever. The body is in the form of a T slot which

controls and guides the cartridges by their cannelures or flanged heads. Centrally through the entire length of the body is a small groove with a hole near the center, through which extends the central portion of the looped locking lever which lies against the rear of the cartridge cases and has a hook at each end to confine the end cartridges and prevent their displacement from the clip. When the loaded clip is forced in the magazine, a fixed wedge cam engages the loop in the center of the lever and turns it partly around, thus releasing all the cartridges in the clip. The weight of the clip, empty, is 76 grains, and loaded with five cartridges 1,736 grains. The weight of 180 rounds of ammunition in the clips is 8 pounds 10 ounces.

DEFECTS OF THE 1895 MODEL.

The Lee straight-pull gun has now been in use five years, and the system as a system has proved itself sound so far as rapid fire, easy action and quick loading are concerned. While, as I have before stated, it did not in the beginning quite come up to the ideal arm looked for by the committee who recommended its adoption, it has been proven beyond the shadow of a doubt that they made no mistake when they took up the straight-pull system. Although the soundness of the system is proven, five years' use of the arm has, as a matter of course, shown some small weaknesses which are easy of cure. They are as follows:

Neither bolt nor firing pin was deadlocked; the extractor was not attached to the bolt; the life of the extractor spring was endangered by excessive strain; the bolt stop was not self-closing; the fly, like all others, was dangerous, and the loading clips were of uneven tension.

THE MODEL OF 1899.

The new model of 1899 eliminates these weaknesses, although the salient features of the gun have not been changed. Several parts have been done away with and a few new ones added, the net result being a reduction of ten parts. Among the parts added is the magazine cut-off, which permits the gun to be used as a single loader while loaded with five cartridges in reserve. As now made it is a reliable weapon, safe, sure and suited to any kind of service ashore or afloat.

The two sides of this model are shown in Figs. 5 and 6 and the detached parts in Fig. 7.

BOLT RETAINER.

The bolt retainer 13, Fig. 7, performs the same functions as the fly 13, Fig. 3, of the 1895 model, and does away with a delicate and dangerous part and its spring. It also does away with the bolt release 20, Fig. 3, of the old model. Dispensing with the bolt release permits a cartridge to be safely removed from the chamber by a single backward motion of the bolt.

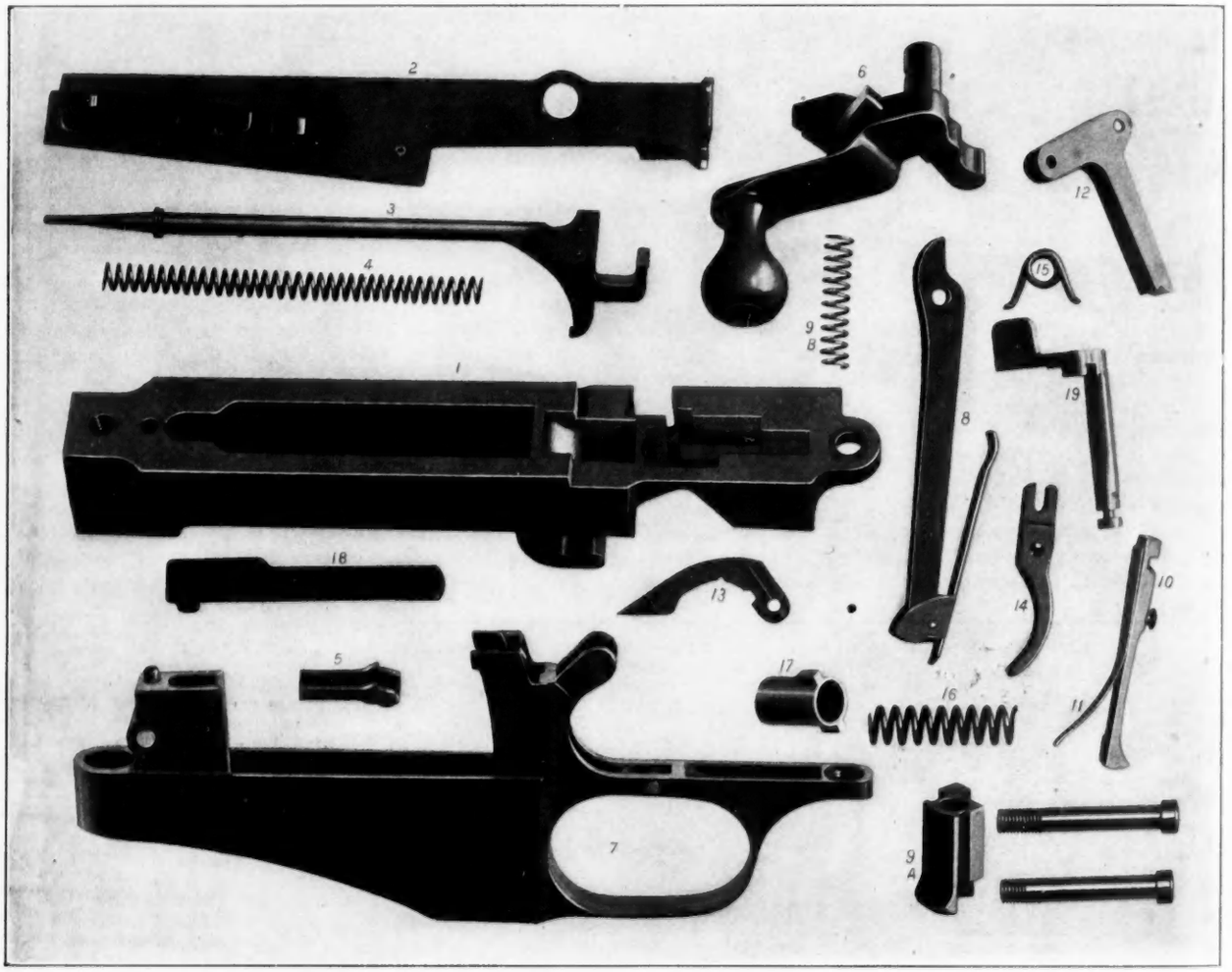


FIG. 7. PARTS OF THE 1899 MODEL.

SAFETY LOCK.

The safety lock 19, Figs. 5, 6 and 7, does away with the firing-pin lock 19, Figs. 2 and 3, and performs the two important functions of securely locking down the bolt to the receiver and of caming back the firing pin and positively securing both. Its operation in principle is the same as that of the swivel safety key in the Mauser and many others. A glance at Figs. 5 and 6 will show how it is reached by the thumb of the operator who always has easy command of the part, and hence the arm, may be carried in perfect safety to the operator and his comrades.

EXTRACTOR SPRING STOP.

This part, 18, Figs. 5 and 7, serves as an abutment against which the extractor spring and with it the extractor is stopped in the forward movement of the bolt. As has been stated, the bolt has a backward movement of 1¾ inches before the extractor is reached, and consequently it has the same length of overrun in the forward movement, during which time the extractor must remain stationary, and the spring being fast to the same is allowed to drop (under tension) into a niche in the receiver, being thereby retained until the bolt has reached a certain position, from which both travel forward together.

As the parts are arranged in the '95 model, when the bolt reaches the contact point and drives the extractor, the spring is driven up out of the niche by main force and when under its greatest tension. In other words, it is made to jump out of the pocket, somewhat deeper than twice its own thickness, and therefore is in danger of being injured or broken, as it is by far the most frail part of the whole system, and should it fail, the arm would be disabled until the spring was replaced.

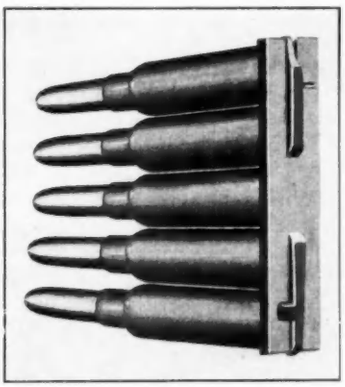


FIG. 8. LOADING CLIP, 1899 MODEL.

SELF-CLOSING BOLT-STOP.

The bolt-stop 9*A*, Figs. 3 and 7, is so arranged that, when occasion requires (and it often does), a spiral spring 9*B* brings the stop home. Such is not the case in the '95 model (see 9*A*, Fig. 3), in which the thumb-piece with clasp spring has a toe to secure same in an indent in the receiver with bolt-stop 9*B* attached, so that when the operator wishes to withdraw the bolt from the receiver, the thumb-piece is pressed down, and remains there until forced home, after the bolt is replaced. Should he forget to perform this operation (and it has happened many times), the next backward movement would leave the bolt in his hand, and the extractor and spring on the ground.

ATTACHMENT OF THE EXTRACTOR TO THE BOLT.

As will be seen from 2, Fig. 7, a T-slot is cut in the bolt, of such dimensions as to easily admit the flanged head of a rivet (see Fig. 7), which secures the extractor 10 and spring 18 for same together. The extreme rear end of the slot is enlarged to permit the entrance of the rivet head. Thus in the working position the extractor will not become detached and a serious annoyance is eliminated.

THE LOADING CLIP.

In the 1899 model this clip, shown in Fig. 8, is in one piece. It is formed with a T-slot which controls and guides the cartridges by their flanged heads. Cut from the body are two springs terminating at their outer ends in inclined hooks, which reach over the heads of the outer cartridges and close them toward each other. At the sides of the springs are projections so arranged as to engage with a fixed wedge hook in the rear end of magazine, by which, when the clip is inserted, the springs are forced back, and unlock the upper cartridge, the clip being retained until pushed out by the next caming. This arrangement of clip allows it to be used in a gun having a cartridge cut off to hold the magazine in reserve while using the arm as a single loader. The unlocking tension of the clip is uniform, and the clip ends are square, to facilitate the loading, as the first act is to push back the extractor from over the loading aperture.

FIG. 9. FULL-LENGTH VIEW OF RIGHT-HAND SIDE OF 1895 MODEL.

FIG. 10. FULL-LENGTH VIEWS OF 1899 MODEL.

THE ARM COMPLETE.

The 1895 model gun is shown complete, from the right-hand side, in Fig. 9, and the 1899 model, from both sides, in Fig. 10.

NOMENCLATURE.

Following is the nomenclature of the parts essential to the Lee straight-pull system. The parts common to all small arms are omitted:

1895 Model (refer to Fig. 3)—No. 1, receiver; 2, bolt; 3, firing pin; 4, main spring; 5, firing pin collar; 6, cam lever; 7, trigger guard and magazine; 8, cartridge elevator; 9*A*, bolt-stop thumb-piece; 9*B*, bolt-stop; 10, extractor; 11, extractor spring; 12, sear; 13, sear fly; 14, trigger; 15*A*, trigger spring; 15*B*, fly-spring; 16, elevator spring; 17, elevator spring shaft; 18, lock pin; 19, firing pin lock; 20, bolt release; 21, trigger spring stop-pin; 22, trigger spring screw.

1899 Model (refer to Fig. 7.)—No. 1, receiver; 2, bolt; 3, firing pin; 4, main spring; 5, firing pin collar; 6, cam lever; 7, trigger guard and magazine; 8, cartridge elevator; 9*A*, bolt-stop; 9*B*, bolt-stop spring; 10, extractor; 11, extractor spring; 12, sear; 13, bolt retainer (new); 14, trigger; 15, trigger spring; 16, elevator spring; 17, elevator spring sleeve; 18, extractor spring stop (new); 19, safety lock (new).

The Dieterich Speed-Varying Device

It is, we believe, a feature of all the numerous friction-driven speed-varying devices in use, that, apart from slippage of the parts as a whole when overloaded, there is a differential slippage inherent to their fundamental construction. In the customary friction disks this is due to the different velocities at different radii of the disk which drives by its face, and in the cone friction in its various forms to the different velocities at different points in the length of the cones. Excellent mechanical authority has, in fact, considered this feature to be unavoidable in a speed-varying device.

The device which we illustrate herewith overcomes this feature and with it slippage due to overloading. Friction is employed, it is true, but as a locking force in the form of a friction pawl, similar to the application in daily use as a clutch for driving punch presses. The drive is, in fact, as positive as that of these clutches. Still another feature is that by which the speed is automatically adjusted to the load. When applied to a bicycle, for example, the "gear" of the machine will automatically adjust itself to the grade of the hills being ridden. Should the grade increase, the gear will be automatically reduced; and should the grade grow less, the gear will be increased. Within the limits set by the construction, a rider may traverse a road of varying grade with a constant pressure on the pedals. Could he be blindfolded and not see the road or his varying speed, he would go from one grade to another without knowing the difference.

We think a mechanism having such properties may fairly be called remarkable. It is easy to criticise; it is complicated, and it certainly is more complicated than a sprocket and chain; but complication is a matter which is to be considered alongside of the results accomplished. Even those who would criticise this gear the most strongly on this basis, cannot deny that the device is of the highest degree of interest.

The automatic feature is not a necessary part of the device, and we shall first describe it without this feature. Except for the later figures, which show the rear hub of the bicycle equipped with the device, the illustrations are to be understood as diagrammatic only, and not as showing practicable construction.

In Figs. 1 and 2 *a* is the driving and *b* the driven shaft, the two being in line. Upon the former a disk *c* and upon the latter a similar disk *c'* are keyed. Radial arms *d e* are mounted loosely upon shaft *a*, and by friction pawls *f g* may be driven by disk *c* when the motion is in the direction of the arrow. Arms *d e* are slotted, as shown, and by pins within the slots drive wheel *h* mounted in bearing *i*, which is supported by the sliding bar *j*. Wheel *h* is shown eccentric to shafts *a* and *b*, and this eccentricity may obviously be adjusted by sliding bar *j* in its supports. It is by this adjustment that the speed ratio between *a* and *b* is varied. A second wheel *h'*, seen in Fig. 2 only, is keyed to the same shaft as *h*, and by a pair of radial arms *d' e'*, pawls *f' g'* and disk *c'*, precisely similar to those at the left, wheel *h'* drives shaft *b*.

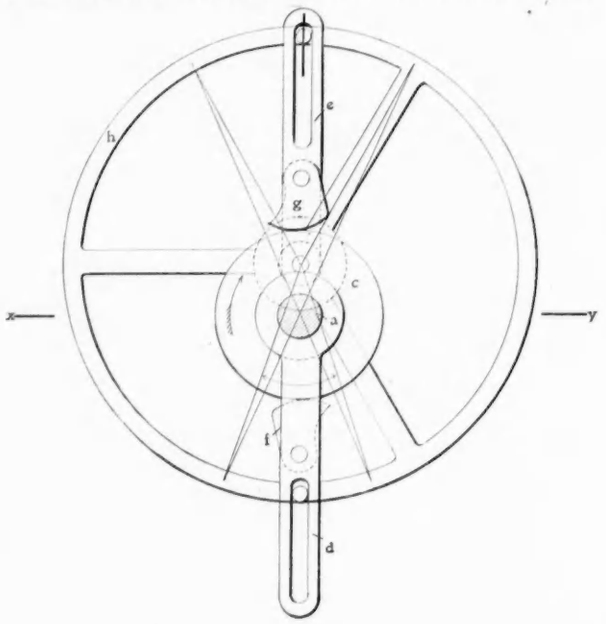


FIG. 1.

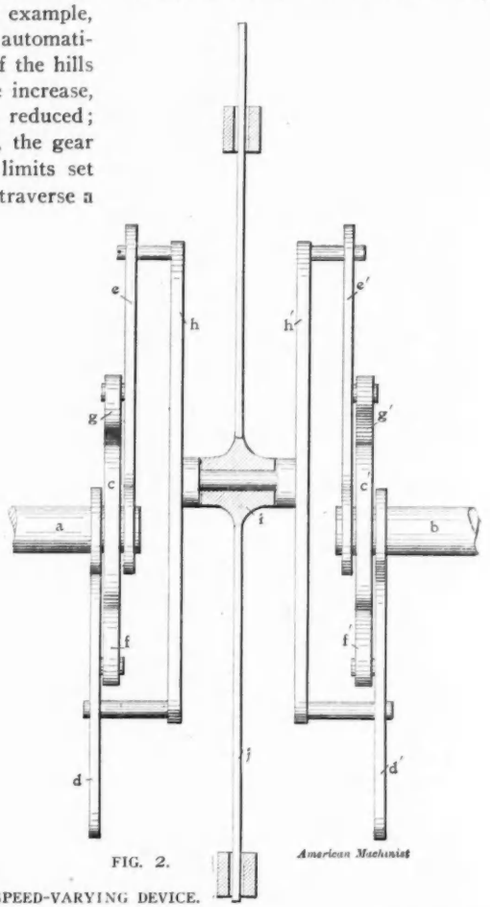


FIG. 2.

DIAGRAMS SHOWING PRINCIPLE OF THE DIETERICH SPEED-VARYING DEVICE.

If the bar *j* be adjusted to bring the bearing *i* concentric with shafts *a* and *b*, it is clear that the entire mechanism will lock itself together and revolve as one piece. Should, however, bearing *i* be eccentric to *a* and *b*, as shown in Figs. 1 and 2, a very different action will result.

In the positions shown, the tendency of disk *c* is to drive both arms *d e* at the same speed, but arm *e*, engaging wheel *h* at a greater radial distance than *d*, will tend to drive *h* faster than will *d*. The wheel *h* will therefore be driven by *c*, and since all parts of the circumference of *h* must travel at the same speed, *h* will drive

d faster than disk *c* tends to drive it. The result will be the loosening of pawl *f* and its sliding along its disk. This will continue until the arms reach the horizontal line *x y*, when both arms will engage wheel *h* at the same radial distances and, for the moment, both arms will drive. As the motion continues, arm *d* becomes the driver, *e* being in turn driven by *h*, its pawl slipping along disk *c* as the pawl of *d* did before.

It is clear that in consequence of the final effect on *b* being the sum of the irregularities due to both sets of radial arms. This addition of the two irregularities is, however, due to the fact that the two sets of radial arms are arranged to act in the same phase. If, instead of arranging the two sets of pins as shown, they were set at right angles with one another, the two irregularities would offset one another, and a regular speed at *a* would be delivered as a regular, but increased speed at *b*. This arrangement is, of course, the one which is actually used. Also three radial arms per set instead of two, as shown, are in reality used.

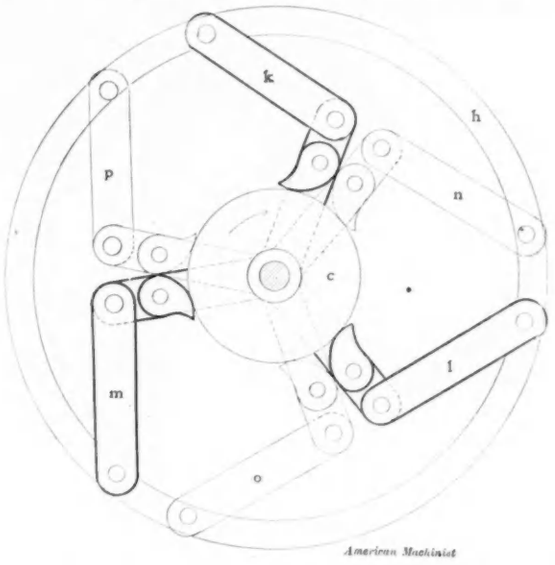


FIG. 3. ARRANGEMENT OF MECHANISM OF DIETERICH SPEED-VARYING DEVICE.

It is clear that such a device applied to a bicycle would give a variable gear, which, however, would require to be adjusted by hand to suit the conditions or the rider's fancy. It remains to show the principle of the automatic feature, which is, we believe, entirely unique. This principle is to so connect the arms *d e* and *d' c'* to the rings *h* and *h'* that the forces transmitted shall have components tending to change the eccentricity. Matters are so arranged that the driving force tends to reduce the eccentricity while the resisting force tends to increase it, and there is thus a constant fight between the two forces. Any change in the resisting force is thus followed by a change in the eccentricity, an increase in the ratio of the forces being followed by a reduction in the ratio of the speeds and *vice versa*. This remarkable result is accomplished by inserting toggle links in place of the pins by which the arms *d e* drive the wheel *h*, and similarly in place of the pins on the driven side. This construction is shown in Fig. 3, the parts being, however, in the concentric position. Toggles *k l m*, drawn in heavy lines for greater distinction, are upon the driving side, while *n o p* are on the driven side. It is clear that in the concentric position shown the device will lock itself together and revolve as one piece, similarly to the construction shown in Figs. 1 and 2, but that the effect of each toggle link is to produce a radial pull tending to displace the wheel *h*. In the concentric position shown these radial pulls will mutually balance one another, and in this limiting position there can be no automatic action. To introduce the automatic action it is only necessary to insert a stop which will prevent the parts from quite reaching concentricity. The wheel *h* is of course guided as to the direction of the eccentric movement by a bar, such as *j*, Fig. 1; the direction of this movement being, as before, vertical. If the wheel be raised slightly to an eccentric position, all of the toggles of the first set, except *k* on the upper side, will be released by the slipping of their pawls, and similarly all of those of the second set, except the lower one *o*, will be released, the result being that these acting toggles of each set oppose one another. By this movement of *h* the upper toggle will be somewhat opened

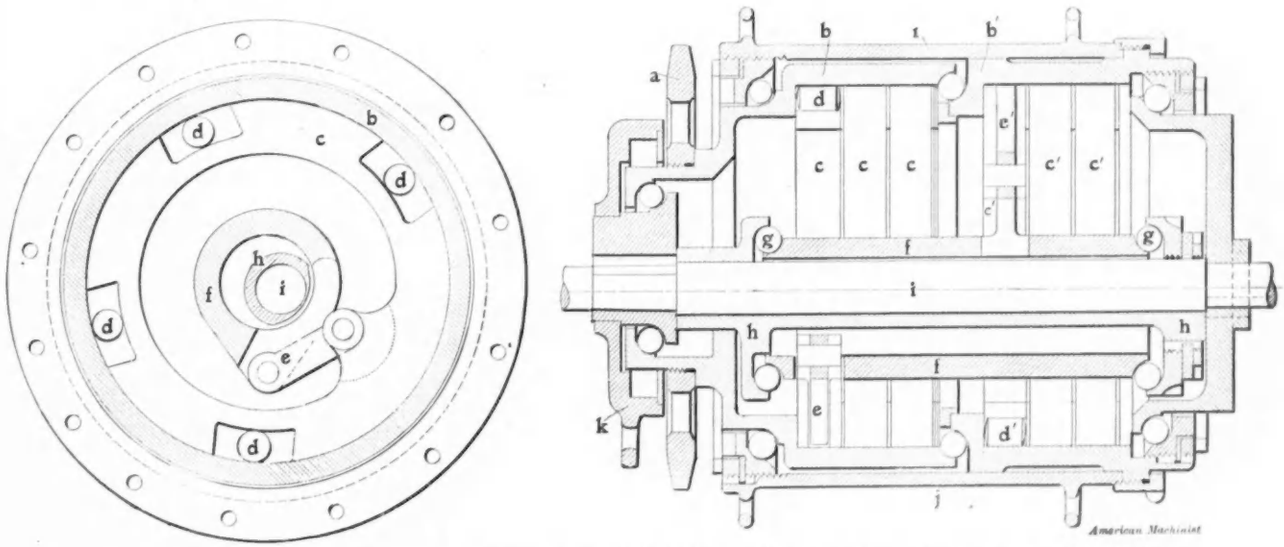


FIG. 4. ARRANGEMENT OF THE DIETERICH SPEED-VARYING DEVICE AS APPLIED TO THE REAR HUB OF A BICYCLE.

eccentric position of *h*, a half revolution of *a* drives *h* through the arc which is above the line *x y*, which is necessarily more than half a revolution, and the action being continuous, wheel *h* hence revolves faster than disk *c*. Wheel *h'* drives shaft *b* in a precisely similar manner, the effect of the right-hand mechanism being added to that at the left. It is clear that if the speed of *a* be uniform that of *h* will not be, and, moreover, that the speed of *b*, as compared with *h* will be irregular, the

out or flattened, while the lower one will be somewhat folded up. Suppose the forces are such as to be initially in equilibrium with *h* in such an eccentric position, and then suppose the load to be increased. This increase will be carried to the wheel *h* and to the pins which connect it to the toggle links. The pressure on the acting pin of each set must be the same, as change of force in the system can only arise with change of speed. The action of the link *k* is to reduce the eccentricity, while that of *o* is to increase it. Toggle *k* being, however, the flatter of the two, it prevents, and the final result is to reduce the eccentricity which reduces the speed, as it should to meet the increased load.

The device has been applied to bicycle construction at the Columbia bicycle works. As thus applied it has little structural resemblance to the diagrams so far shown, and is, in fact, inverted. In addition to this the piece corresponding to the ring *h*, of Figs. 1, 2 and 3, swings upon the arc of a circle instead of being guided in a straight line. Fig. 4 shows sections of a rear hub having the device enclosed within it. At *a* is the sprocket which is secured to the shell *b*, which corresponds to the disk *c* of the previous figures. At *c c c* are three rings with roller clutches *d d d d* connecting them with shell *b*, these clutches corresponding to the friction pawls of the previous figures. At *e* is one of the first set of toggle links connecting the rings *c c c* to the piece *f*, which corresponds to the wheel *h* of Fig. 4. This piece revolves in ball bearings *g g*, the ball races in the support *h* being eccentric to the stationary axle *i*, so as to permit the bodily swing of *f*. At the right the pieces are repeated for the second set as lettered, the motion being finally carried to the shell *j*, to which the spokes are attached. The piece *k* is part of the coaster brake and has no necessary connection with the device being described.

There are more fields for the application of a successful device of this kind than would be imagined at first sight. Its application to machine tools is obvious. Applied to gasoline engine automobiles it would enable the engine to run at a fixed speed, and on electric automobiles it would substitute a constant-speed motor for the present series wound machine and put a starting box in place of the controller. It has been suggested to apply it to freight elevators, where, with a constant engine or motor speed and torque, it would give a variable speed to the platform in accordance with the weight being lifted. On cotton and other presses it would reduce the speed and increase the pressure as the compression proceeded. In an inverted form it might be made to connect a lighting dynamo with the axle of a railroad car—the speed of the dynamo being constant regardless of the speed of the train above a certain point. In a similar way it might make the driving of dynamos by windmills practicable. We do not, of course, mean to predict that this device can be successfully applied to all these places, but the list will give some idea of the possible field for devices of this character.

It should be noted, as regards its mechanical practicability, that the roller clutch on which it depends is in wide use under severe service in punch and other presses, and that, as regards the links and pins, their duty is small because of their slight amount of motion relative to one another.

The device is named from its inventor, the Dieterich gear, and is controlled by the Dieterich Gear Company, of 862 Asylum avenue, Hartford, Conn.

A Remarkable Case of the Flow of Metal Under Pressure.

BY F. A. HALSEY.

Some years ago, while doing some experimental work for the Rand Drill Company, some instances of the flow of metal (in this case copper) under pressure occurred, which were more pronounced than any which I have seen recorded. Having recently unearthed some specimens which were saved at the time, I have thought an account of the results would be of interest, and hence give them here.

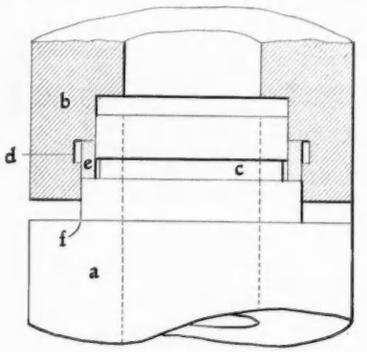


FIG. 1. THE DERBY JOINT AS PUT TOGETHER.

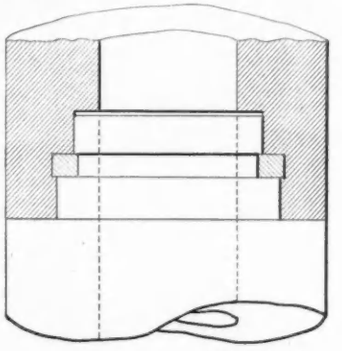


FIG. 2. THE DERBY JOINT AS SECURED.

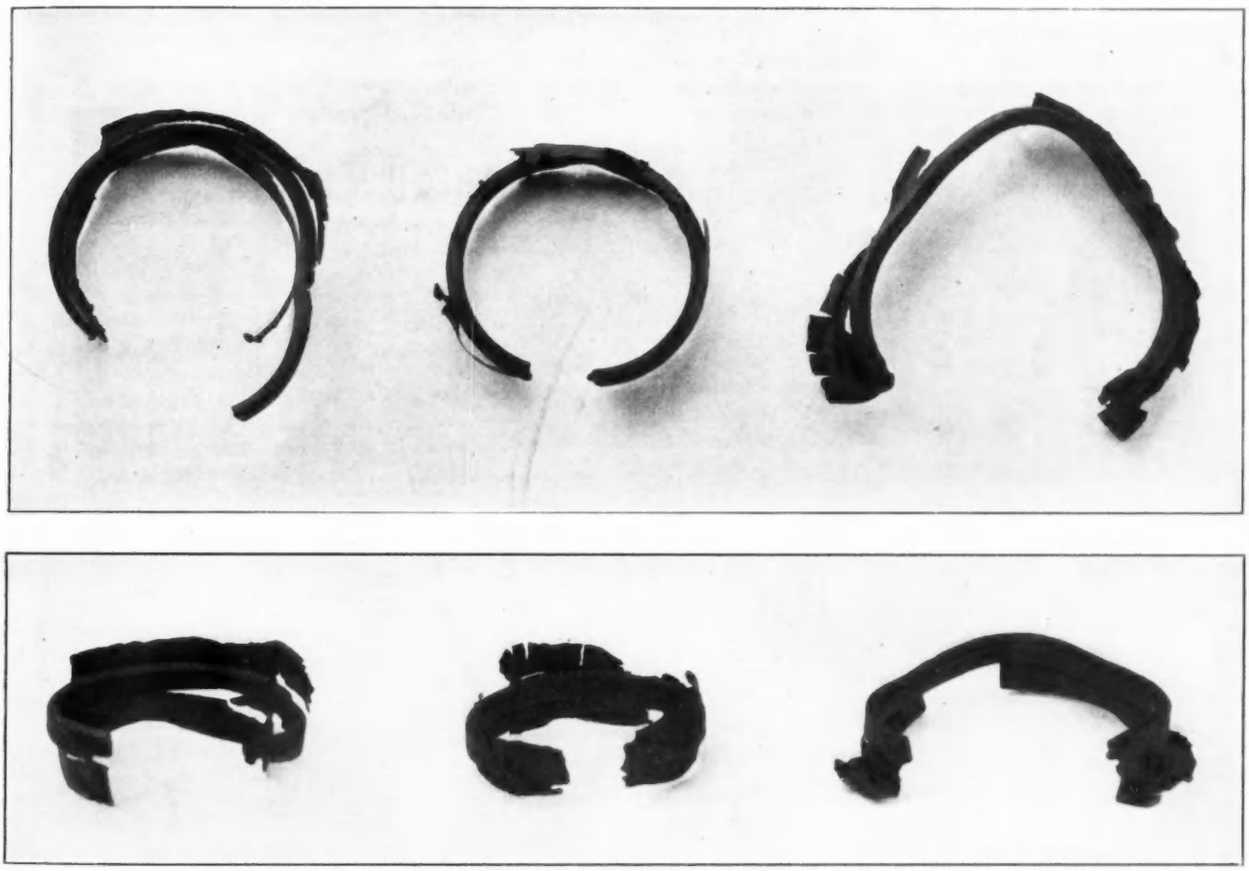
Captain (at that time Lieutenant) Derby, U. S. A., was, during most of the time of its execution, in charge of the work of excavating the famous Flood Rock in Hell Gate, at the junction of Long Island Sound with the East River. After the excavation of the galleries was complete, numerous holes were required in the remaining piers and in the roof for holding the charges of explosive which were to break up the piers and roof, preparatory to final removal by dredging. These holes were to be of a larger size than could be made to advantage with rock drills, as usually used, and Captain Derby devised and used a new system of bit for making these holes, which system he subsequently sold to the Rand Drill Company, and it was in experiments for the commercial development of the invention that this experience occurred.

The invention involved a separable bit to be attached to the ends of pieces of heavy pipe of various lengths, instead of being, as usual, forged on the ends of bars of drill steel. When the punishment to which rock-drill bits are subject is considered, it will be seen that the problem of securely attaching the bits to the ends of the pipe sections was not a small one, and Captain Derby solved it by as pretty a piece of invention as one often sees.

Figs. 1 and 2 show this invention—the figures being sketched from memory. The pieces to be joined, *a* and *b*, were turned at their ends, male and female, as shown, and each piece had a groove *c d* turned upon it. A copper ring *e*, of, initially, the cross-section shown in Fig. 1, was placed over the end of piece *a* when piece *b* was passed over the ring, as shown, the sizes being such that this could easily be done with the hand. It will be seen that blows upon the end of piece *b* would upset the copper ring and that when the piece *b* had reached its ultimate position, Fig. 2, the cross-section of the ring would be changed from a rectangle to a square of the same area, the pieces *a* and *b* being, so to speak, riveted together. The original cross-section of the ring was, of course, calculated to be such that it should equal the square which it was ultimately to become, while its thickness was such as to permit the parts to go together. An initial blow of the parts, while held in the hand, upon the surrounding rock would deform the ring enough to prevent the parts from falling apart, and a few blows by the machine would do the rest. This form of connection, it may be said, was completely successful for the purpose—in fact, the problem eventually became one of getting the pieces apart, instead of making them hold together.

In the experimental work the parts *a* and *b* were turned in a common lathe without gages, and of course a high degree of uniformity was not obtained. The copper rings, moreover, were cut from sheets with a pair of tinner's shears, and of course considerable variation in them was inevitable. With rings having too small a cross-section to fill the space provided, the result was of course simply a tendency to looseness of the parts, but with those of too large a section a very interesting condition of things developed. With

such rings the grooves would become full of copper before the main pieces came together as intended, and after this condition of things was established additional blows would subject the rings to pressure from all directions. When the number, rapidity and power of the blows delivered by a rock drill are considered, it will be apparent that this pressure would be something tremendous, and, moreover, that it could only be relieved by the copper flowing into the joints between the pieces *a* and *b*. That such flow should take place to a limited extent would be expected, but



FIGS. 3 AND 4. PHOTOGRAPHIC VIEWS OF THREE DERBY JOINT RINGS HAVING A SURPLUS OF METAL.

that it should take place to the extent that it did is probably beyond all previous experience.

Figs. 3 and 4 are from photographs of some of these rings having a surplus of metal. In the left-hand and center views the flow was both upward and downward, its extent being shown by the places where the flowed portions are partly broken away from the main body of metal in the center. In the right-hand view the flow was entirely downward. The rings are badly deformed from the effort required to remove them from the groove after the pieces had been drawn apart, but the extent of the flow of the copper in the joints is apparent. In the right-hand piece the flow will be seen to have been so great as to have turned the corner *f*, Fig. 1. It it natural to suppose that the turned-out portion was flattened by the direct hammer blows upon it, and so is, perhaps, somewhat wider than it would have been from the flow alone, though the micrometer shows the thickness of these turned-out portions to be greater than in parts of the other specimens. In this piece the length of the flow, including whatever effect there may have been from the hammer action, is about 7-16 inch. In the other cases, in which a corner was not turned, the flow often reaches ¼ inch, and in one place equals ⅜ inch. The thickness of the streams lies mainly between 3 and 5 thousandths of an inch, though places as thin as 1½ thousandths and as thick as 8 thousandths can be found.

It will be observed that in the joint below the copper ring, the movement of the parts *a* and *b* upon each other is such as to assist the flow, while in the joint above the ring the effect is to oppose it. This, however, did not seem to make much difference. In the ring having the longest flow, this flow was downward, but in the others it was both upward and downward. The comparative tightness of the two joints seems to have largely determined which way the metal should go.

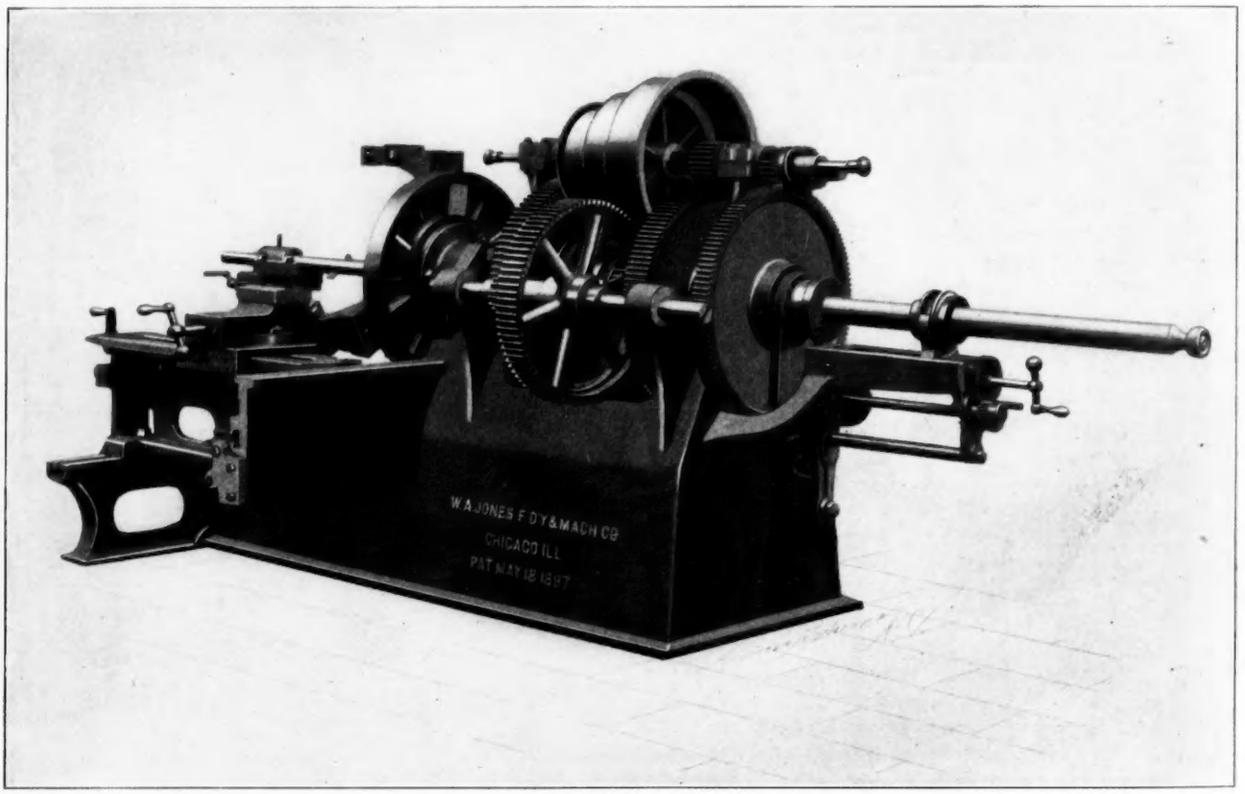
A Special Chucking Lathe.

The machine shown in the half-tone is known as the Foss boring and turning machine. It is, in fact, what is better known to the trade as a chucking lathe. It is best adapted for turning and boring pulleys, sheaves, flywheels, etc., where all the work may be done while the piece is secured to the face-plate. The machine here shown swings 54 inches in diameter and will work to a width of 48 inches. The main spindle is 5½ inches diameter, and through this runs a boring bar 2 15-16 inches diameter, in an adjustable taper sleeve. The boring bar is made to turn in either direction, which gives it a considerable difference of cutting speeds relatively to the work, so that for boring large holes it will run in the same direction with the main spindle, and for small holes or light cuts it will run in the opposite direction. The bar also is made to feed and cut in either direction. The bearing for the front end of the bar, although always ready, is not required, except for long holes and heavy work. Both the drive and the feed of the bar are easily seen at the back of the lathe. The bar slides with a feather through the large gear, and this is reversibly driven by the tumbling gears which connect it with the small gear on the cone pulley shaft. The boring bar feed train is driven by a two-step feed cone outside the large gear. The rotation of the feed screw is reversible, and the feed nut opens, so that the bar may be slipped back and forth.

The lathe may be run with either compound or triple gearing, according to the speed required. For the triple gear, the pinion on the cone shaft at the large end

of the cone is slipped into mesh with the large gear below it, as shown. The sliding of the pinion is done by the rod projecting from the end of the shaft. This large gear turns freely on the main spindle, the other end of the sleeve to which it is fastened carrying a pinion which meshes into the large gear on the intermediate shaft, and a pinion on this shaft meshes into a large gear on the front of the spindle, thus driving it at its slowest range of speed. The intermediate shaft slides endwise in its bearings, throwing both its gear and pinion out of mesh, and it is here shown in this position. A pinion on the other end of the cone shaft slides into mesh with the large gear of the spindle for its faster range of speeds.

The lathe has a tool carriage slide on each side, only one of which appears here, the two being arranged so that they may be adjusted from one side to close or open for any diameter of work. The top guides are provided with compound tool-post heads which can be set to turn straight or taper in either direction. The tools also each feed in either direction independently of the other. In turning pulleys, therefore, the cuts may both be started at once from the middle and each feed outward toward its own edge. There is also another adjustable compound tool carrier which may be used for boring or facing. The feeds for the tools are entirely separate from and independent of the bar feed. There is a three-step cone on the main spindle, seen through the arms of the gear, and this belts to another cone below, which drives the feed mechanism. The face-plate of the machine is slotted, and is fitted with movable arms which enable it to take work of almost any description. The machine is built by the W. A. Jones Foundry & Machine Company, North avenue and Noble street, Chicago.



A SPECIAL CHUCKING LATHE.

Two Honest, Unbiased and Infallible Trade Journals.

At page 938 of this volume we printed an article under the above title which referred to the experience of Loring Coes & Co., of Worcester, with the "Southern Review of Commerce," of Louisville, Ky., and the "Southern Trade Record," of Cincinnati. It was an experience of letting them alone, so far as Loring Coes & Co. were concerned, and we published the matter not because we believed any great numbers of our readers needed to be warned of such a very transparent game, but mainly as a matter of curiosity, and to show one of the peculiar ways in which some people pursue the elusive dollar. Our article has called out quite a lot of further information regarding these publications and their ways, and we have before us a copy of the "Southern Review of Commerce," which, as Professor Thurston puts it, "purports to have been issued" May 16th last. The copy before us contains an article which is as follows:

THE BEST SCHOOL OF MECHANICAL, CIVIL AND ELECTRICAL ENGINEERING.

"Since the publication, some weeks ago, of an editorial commenting on the great and ever-increasing opportunities to gain fame and money in the fields of mechanical, civil and electrical engineering, several young men and a number of solicitous parents have taken occasion to ask the 'Review's' opinion and advice in regard to the best place to learn engineering, cost of such education, advisability of taking a correspondence course, et cetera.

"Feeling that it would be doing its subscribers a real service by looking into the matter for them fairly and impartially, the 'Review' has caused its staff of correspondents in different sections of the country to interview a large number of civil, mechanical and electrical engineers, and to obtain from them candid expressions of opinion on the subject.

"Correspondents have also visited a number of institutions, the shop and laboratory equipment of which have been carefully taken note of.

"Making due allowance for that natural enthusiasm which every alumnus has for his alma mater and taking all things into consideration, it is our opinion that Stevens Institute of Technology at Hoboken, N. J., is the best equipped in the country.

"We must refer inquiries directly to this institution for more detailed information, such as cost of tuition, living expenses, outline of courses, etc.

"The 'Review' will also state very emphatically that it cannot advise any one to take one of the widely advertised correspondence courses, for in all engineering courses constant personal supervision of the student's efforts and as much prac-

tical work as possible are essential to success. We find professional opinion to be opposed to the correspondence schools; some of them are doubtless 'catch-penny' schemes; others may be conscientious enough, but can do little more than impart a purely theoretical knowledge.

"Those who have written us on the subject may consider this our reply, and, further, may feel assured that it is actuated by the desire to give credit where credit is due, to answer inquiries and to call the attention of readers to what we have every reason to believe to be the best school of engineering in the country."

It will be observed that the paragraph next to the final one of this article appears to have been "lugged in," so to speak. The practiced eye will easily perceive in it signs of the familiar "nigger in the woodpile," and just for fun we wrote to three of the best known correspondence schools, asking them if they had not "turned down" some of the propositions of this enterprising journal and thereby incited its editor to believe that correspondence schools are no good. Sure enough, from the International Correspondence Schools at Scranton, Pa., we promptly received evidence that both the papers mentioned have prepared the usual cut-and-dried and highly eulogistic editorial articles, and have submitted them to the school in question, with the usual suggestion regarding the purchase of copies of the papers containing the article at prices which the term extravagant hardly describes. But the copies were not purchased, and the advertising manager of the school, whose special business it is to be able to recognize an advertising fake when he sees one, and to know the difference between spending money for good advertising and throwing it away, wrote them, "We regret that we are unable to avail ourselves of that form of advertising." The American School of Correspondence, Boston, sends us a sample of an editorial article which they say they have received at intervals of two or three months during the past year, but which they have never paid any attention to. In this article which the "Southern Review of Commerce" submitted, it is declared that inquiries have been received as to correspondence schools, the usual careful and thorough investigation has been made, and as a result the school is commended in their usual frank and unreserved, not to say flamboyant manner. The other schools tell us substantially the same tale, but the numbers of the "Southern Review of Commerce" offered for sale, to contain the proffered article, not having been ordered, the many people who have inquired not only do not get the information which we are given to understand they are anxiously awaiting—even thirsting for—and which the able editor's "careful and thorough investigation" has made ready for them, but on the contrary they are warned against having anything to do with correspondence schools.

Professor Thurston writes us that an article precisely like the one quoted above, but having Cornell University in place of Stevens Institute, was sent to Cornell, and he remarks, "I presume they had discovered as many 'best schools of mechanical, civil and electrical engineering' as they could find institutes upon which to play their little game, and very likely that set of swindlers is operating on 'all sorts and conditions of men.'"

From A. L. Henderer's Sons, of Wilmington, Del., we have the manuscript of an article that the "Southern Trade Record," of Cincinnati, proposed to publish, and which is worth perusal; for the ludicrous reason that it hopelessly mixes two unrelated things, the writer of it having of course no technical knowledge whatever to guide him. It reads as follows:

AN ARTICLE OF INTEREST TO MACHINISTS.

"During the eighteen years the 'Southern Trade Record' has been in existence it has always endeavored to render its readers the best possible service in keeping them supplied with news of all that is latest and best in the line of things pertaining to the the industrial growth and welfare of the South. We believe that we have succeeded in accomplishing our object, and our readers appreciate our efforts in their behalf, as the rapidly increasing subscription list attests. The machine industries of the South have received a great deal of attention, and we have endeavored to place before our readers all that is of value in the way of supplies and improved machinery. We have recently received a number of inquiries relative to mandrels that can be handled and set in close places, asking if there is any special make of mandrel or some other tool that would serve the same purpose in places where a hammer could not be used to drive the mandrel. In our investigation we failed to discover any kind of a mandrel that could be used without hammering, but we found a very efficient appliance that serves the same purpose and does the work equally as well as a mandrel would. The device we refer to is the Furgerson self-feeding expander, made by A. L. Henderer's Sons, of Wilmington, Del. This device does the work well, and is greatly superior to hammering for any work. It is made to screw right or left-hand. It is efficient, durable and economical, in that it saves a great deal of time on difficult jobs. No machine shop should be without the Furgerson self-feeding expander, for it will save its cost in a remarkably short time. Space forbids the publication of the details of our investigation, but we will say in passing that great stress was laid on the opinions of a large number of expert machinists who have made practical tests of its efficiency; on the fact that nearly all the best machine shops in the country use this device, and on its great and growing success, as demonstrated by its ever-increasing sales. Those who desire further information and details can obtain same by addressing A. L. Henderer's Sons direct.

In conclusion, we wish to state positively that we have no interest in this firm or its product, other than to give credit where credit is due, that our interested readers may know where the best in this line can be obtained."

As this has not been published by the "Southern Trade Record," and does not seem likely to be, perhaps some few of its many readers who are anxiously awaiting the result of the investigation into the lathe arbor question may get the information they thirst for from our columns. Messrs. Henderer's comments upon it are as follows:

"We enclose you this, one of the many we have received, as it is particularly amusing to us to note that they recommend our roller tube expander (a boilermaker's tool) for the work of an expanding lathe mandrel."

In the number of the "Southern Review of Commerce" which we have before us, we noted, prominently displayed, the advertisements of two well-known tool-building concerns. Believing they never had paid money to such a palpably fake sheet, we asked them about it, and both replied that they had never ordered any advertisement nor paid for any, but had been asked for electrotypes, and without stopping to investigate the matter particularly, had sent them. It is needless to say that these electrotypes are used simply to give the paper an air of genuineness and to influence others by making them think that such leading and well-known concerns are *bona-fide* advertisers.

The list of things that are commended as the best of their kind in the number of the paper referred to shows remarkable versatility on the part of its editors; if, indeed, it does not show that its editor, like Geo. Francis Train, has "absorbed all knowledge." It includes engines and boilers, dye works, teachers' agency, potter's chemist, optical college, cigars, mining engineer, graphophone, firm of ironworkers, harrows, commission merchant, tobacco knives, patent and enamelled leather, telephone, farm wagons, oils, hand-made harness, seeds, tobacco planter, lumber and shingles, Portland cement, grills, red-cedar shingles, school of mechanical, etc.; shippers of hay, grain, etc.; brick machine, fertilizers, cigarette paper, incubator, fanning mills, dictionary, vermillion paints, cotton yarns, cure for drug habit. All these are commended in substantially the same terms, and it is scarcely conceivable how anyone fit to be outside the protecting walls of a retreat for mental cripples could pay any attention to their commendations, or could believe that any other sane person would give them any attention.

"And My Language is Plain."

Our contemporary, the "Roller Mill," has been after a fake sheet coming within its field, and recently expressed itself in the following trenchant language:

"'U. S. Health Reports' is a lie, fake, fraud, cheat, sham, sneak, snare and de-

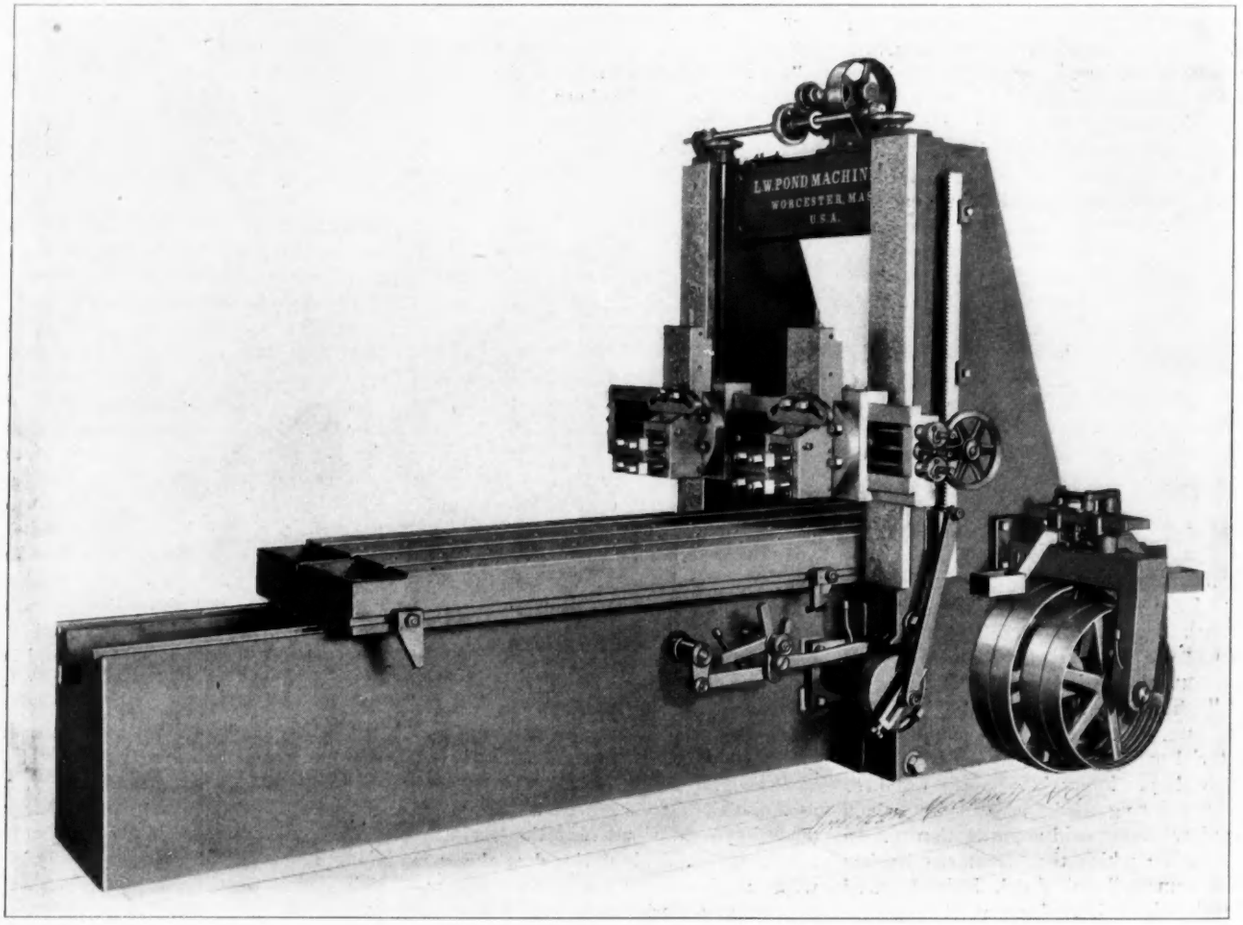
lusion. It has absolutely no standing or authority whatsoever. Its editor and publisher are scoundrels, its 'doctors' and 'chemists' are mere names, its 'laboratories' are myths, its 'reports' and 'analyses' are stereotyped rot. After the repeated warnings which have been uttered against publications of this class, we fail to see how any honorable miller of sound mind can be induced to do business with them."

A Straight Line Planer.

We give an illustration of a planer which is called a "straight line" planer, a name which will be seen to be appropriate after a little contemplation of the general appearance of the machine, in which every curved line possible to be eliminated has been eliminated and a straight one substituted. The following particulars are given regarding the machine:

It is a 36x36-inch planer, to plane 8 feet long. The planer shown has two heads, but can be furnished with four heads, and to plane any length, the bed being so deep that it can be made any length without changing the design. The planer is given ample power to carry all four tools to their full capacity at the same time, as it has gearing with wide face and coarse pitch, and great ratio through four shafts, driven by a 24-inch pulley for 3-inch belt, with a backing pulley of 20 inches diameter. The loose pulleys run on dead bearings. The countershaft has pulleys to give a return of 3 to 1. The shafts of the planer are of steel of large diameter, namely, 3¼, 3, 2¾ and 2½ inches, with long bearings, which have both oil and felt groove. The pinions are of steel, and gears of cast iron, made in their own foundry of a special mixture giving additional strength of 33 per cent. by test. The feed is by a ratchet feed-box of simple construction, giving positive feed. The bed is 24¼ inches deep, with large and accurately fitted bearing surfaces on the two V-tracks, which are oiled by rolls. The table is 5 inches thick at center and edge, 8⅛ inches through track, making two solid walls, tied together on the inside by webs. The shifting of belts is by a cam which throws one belt in advance of the other, and is controlled from either side of the planer. Ball bearings are under crossrail screws and slide screws. The smooth, straight sides of planer do not admit of the accumulation of dust and dirt.

This planer is the latest design of the L. W. Pond Machine Company, Worcester, Mass.



"STRAIGHT LINE" PLANER.

The "Cologne Gazette" on American Machine Tools.

The "Cologne Gazette" comments editorially upon the machine-tool exhibits at the Paris Exposition. "Of all exhibits," the "Gazette" says, "the American are the most interesting. They are full of lessons, from which all Europe can learn and profit. Less than forty years have elapsed since the Americans imported all their machine tools from England. To-day the reverse is the case. This fact is explained in the first place through general circumstances in which all countries of Europe, with the possible exception of Russia, differ from the North American Continent. In Europe, raw materials are expensive, but wages are low. In the United States, raw materials are cheap, but wages are high. The high wages, however, have to a certain extent brought about the cheapness of raw materials. Nothing is more certain than the mutual relations between these two facts. In Europe, on account of the scarcity in raw materials, there prevails a general parsimony. This fact explains in the first place the manifold chemical and metallurgical inventions which are constantly being made on this side of the Atlantic. In the United States, however, efforts are made

in almost every direction to save labor. Hence this variety of machine tools. The European who makes a trip through the United States, when he returns to Europe declares again and again that the United States is a country of wastefulness, as far as raw materials are concerned. The American, on the other hand, who comes to Europe, never fails to declare that Europe is 'a slow country,' because we make, for instance, our boots and shoes as yet by hand, which in his country is only done by machinery. Europe, therefore, is, broadly speaking, the land of chemistry, while the United States is the land of applied mechanism. This, of course, is not to be understood in an exclusive sense. The two hemispheres supplement themselves. The Americans recognize readily the advantages brought about by our chemical and metallurgical inventions."

The "Cologne Gazette" then pays a high tribute to our machines, mentioning especially the exhibits of the Brown & Sharpe Manufacturing Company, saying that their measuring instruments are for America what are the makes of Armstrong Whitworth for England. The "Gazette" has also interviewed an American machine-tool maker in Paris. Our countryman told the writer of the "Gazette" something about our working system. Says the "Gazette": "The American manufacturer whom I had the pleasure of meeting in Paris was a man of perfect education and clear ideas. 'The American workingman,' he said, 'does not complain about mechanical improvements as do most of your men. He is always willing to operate several machines and has no objection to his employer putting two machines on the same driving belt. The English workingman with his unreasonable demands is about to ruin the industry, as is also the French. But I suppose this is the fault of the system practiced in Europe, as the very same man who makes obstructions in Europe and who asks for impossible things, as soon as he emigrates and settles down in our country, breaks off with the whole nest of his European ideas and adapts himself to our system. We pay him better wages and treat him in every way as a 'man.' Our system is good for both parties, the employer as well as the employee. In the shops of Europe, it is the employer and his managers who do all the thinking; we, however, train our men to think with us and for themselves.'"

The whole article culminates in the expression of the highest esteem for our tools. Great attention is paid to Fay & Egan's wood-working machines, to Pratt & Whitney Company lathes and multiple drilling machines, etc.

That the admiration extended by the "Cologne Gazette" to our machine tools is shared by the majority of German mill-owners has best been proved by the fact that during the fiscal year 1899 our exports of metal-working machinery to Germany amounted in value to no less than $2,638,403, or more than 40 per cent. of our total machine-tool exports. H. S. G.

Letters from Practical Men

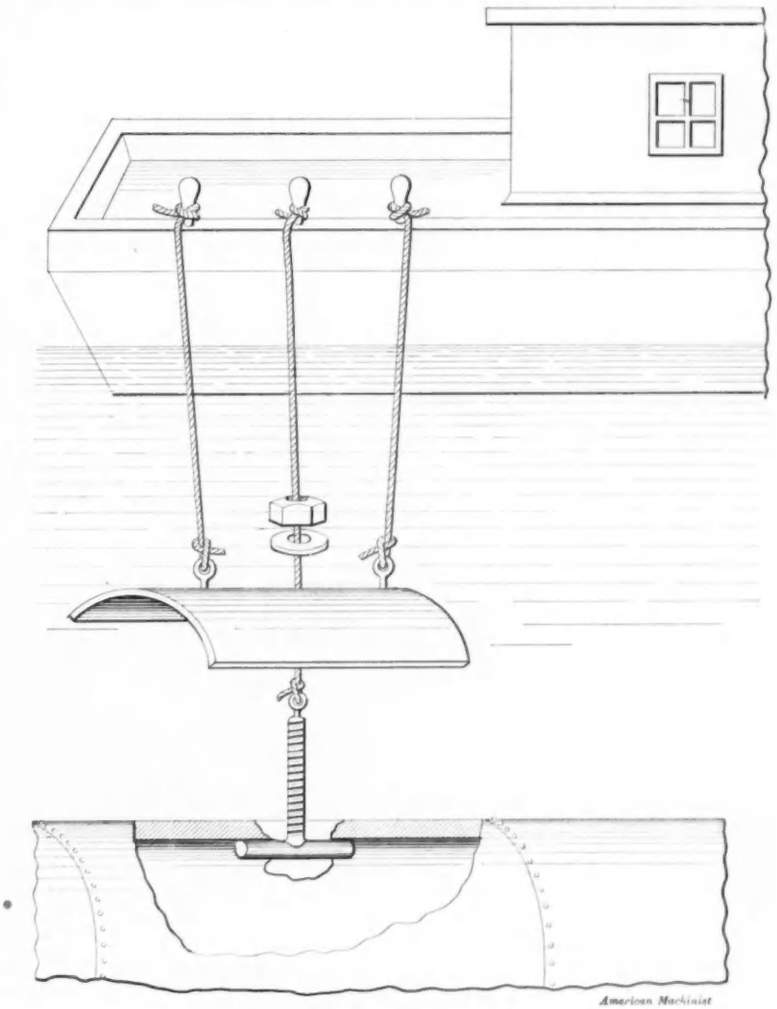
Repairing a Water Main Under Water.

Editor American Machinist:

I send you a sketch showing a neat way of getting out of a bad scrape. The "scrape" in this instance was made by the scoop of one of the powerful dredges engaged in cleaning out the Cuyahoga River, Cleveland, Ohio. The dredge shoved its scoop into a 33-inch water main, making a hole in the big pipe about 4x8 inches. The water in the big main was at once turned off, and the water works officials gathered at the scene. Various plans for the repair of the pipe under the water were discussed, but all of them cost too much money. The Deputy Director of Public Works was finally called upon to devise a plan to meet the emergency; this he did in a very short time, and he proceeded to carry it out as follows:

He secured a scow which he anchored above the pipe. A diver was then sent down to the broken main, carrying with him a "T" bolt having an eye screwed into the end. The T bolt was then placed in the hole lengthwise and turned round so that it would hold. A rope through the eye and fastened to the scow held the bolt in position. The iron patch, with a rubber gasket, followed by a nut and washer, was lowered down over the bolt, as shown by the sketch. The nut was then screwed down tight by the diver, compressing the gasket between the patch and the main, making a good tight joint all around.

The repair, as described above, made under 20 feet of water, cost the city about $100. Under any other plan it would have cost $500, which goes to show that city officials do try sometimes to save the city money. P. S. B.



REPAIRING A WATER MAIN UNDER WATER.

Hobbing a Right-Hand Worm Wheel with a Left-Hand Hob.

Editor American Machinist:

In your issue No. 42, Mr. Christman tells of a very interesting piece of work, but carelessly gets his figures wrong. Fig. 1 shows the gashing as it would be for a

left-hand worm. Fig. 2 shows it the same way, while Fig. 3 shows it for a right-hand worm. Some of your readers may doubt the possibility of accomplishing the feat described when they note this discrepancy in the cuts; but it is not only feasible, but quite satisfactory, and if it were not for the error in the cuts they could see it at once. L. C. DANSE.

[Several other readers have pointed out the same error, and while we doubt if anyone was misled by it, the occurrence leads us to remark that editing the "American Machinist" is "no cinch."—Ed.]

Chucking Circular Saws for Grinding the Holes.

Editor American Machinist:

I send you a sketch of a device which I have designed and used successfully in grinding the holes of circular saws. It

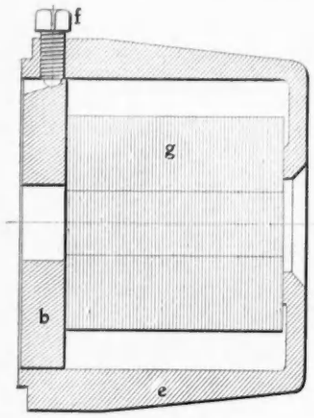


Fig. 2

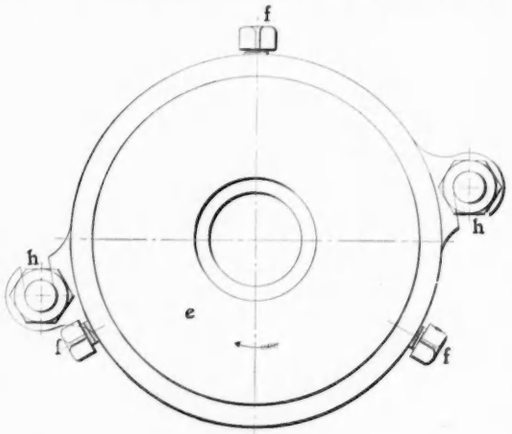


Fig. 3

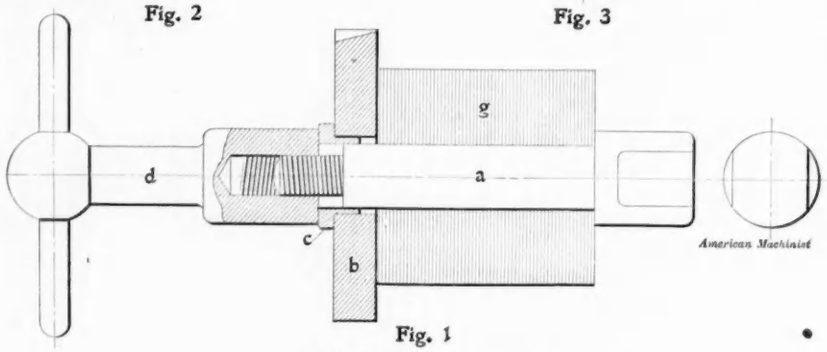


Fig. 1

CHUCKING CIRCULAR SAWS.

has proved to be a great saver of time over the old way of handling them singly, either on a grinding machine or by the dirty and dangerous method of lapping with copper or lead arbor with loose emery and oil.

The saws *g* are firmly clamped to the disk *b* by the bolt, nut and bushing *a, d, c*, Fig. 1. It is then placed into the chuck *e* and fastened by the screws *f f f*, after which the arbor is removed and it is ready, as seen in section in Fig. 2, to be clamped to the grinder face-plate, which of course must be recessed to receive it. The object of bushing *c* is to center the work as well as to provide clearance for the emery wheel when removed. The other end is centered in chuck *e* by the head of the bolt.

About the "micrometer caliper for measuring the radius of spindle drills, and similar pieces impossible to measure directly," in your issue No. 34, you are right in saying that the constant ought to be as simple as possible—perhaps 1.1; the only difficulty is then to get the angle of the anvil correct. OTTO ECKELT.

Berlin, Germany.

Good Law.

Editor American Machinist:

That is an interesting case recently reported from Chicago. A firm there, not in our line, but that makes no difference, had a foreman in their employ at the munificent wages of $18 a week. This foreman had in some formal way, I don't know whether by word of mouth or by writing—and that doesn't make any difference to me either—agreed to work for the above wages, to give his whole time to the company and not to work for anybody else. He worked under this arrangement for two years, but it seems that the firm for whom he worked assumed that it was to hold for ever and ever, and when he went to work for another concern they got a preliminary injunction to prevent him. They said he had peculiar skill, and that they couldn't find another like him—a foreman for $18 a week.

And here's where what I call good law came in. The judge in his decision dissolving the injunction, said:

"No court in any country where the common law prevails has ever attempted to compel one man to work for another, no matter how solemnly he has contracted so to do. It is to be hoped that many years will elapse before such a decree will be entered. In the judgment of this court it is against public policy to force an unwilling servant to work for his master, or an unwilling master to keep a servant after their relations to each other become strained and distasteful. To force them into daily contact with each other under such circumstances would be fraught with much more evil consequences than might flow from the breach of the contract of employment. Better far to leave them to their remedies at law (presumably an action to recover damages for breach of contract), even though inadequate, than to force association and personal contact between hostile and unwilling parties. But it may be said that there is a difference between enjoining a man from working for others and compelling him to work for one man in particular. In effect there is none. To say to a man, 'Work for me or nobody,' if that man be, as is alleged of defendant, without means, is to say, 'Work for me or starve.' Such a heartless verdict should not go out of a court of equity."

This is common sense, and that is better than some law; and no law is better than that.

It has happened that I have lately had more than usual occasion to think about this sort of thing, so that now is just the time for me to speak of it. I believe that there should be a free and open market for a fellow's abilities, whatever they may be. He should be informed as to the fluctuating demand for services such as his, and he should be free to avail himself of any advances. The present arrangements provide well enough for the declines, so that he needn't worry about that side of it.

Any arrangement that interferes with a man's free bargain and sale of his work is a serious thing, and yet there is much more of it than it is pleasant to acknowledge. The case that came before the Chicago judge was an outrage, of course, and it was lucky that the law could have its say about it. But there is a lot of the same kind of thing going on continually that no law can reach. I once lived and worked in a town where there were three or four concerns all in the same line of business, and it was well understood by every fellow in the town that, whichever shop he worked in, if he left it for any cause, either by discharge or of his own choice and motion, he would be refused work in all the others. I knew many fellows who at different times tried it, who tried it when men were scarce and in great demand, and they always failed. If they didn't get back into the shop they left they got out of town. Now, here was the precise condition which the judge condemns. A or B or C or D

could say (not aloud, but to himself), "My man, if you don't work for me, you can't work for the others." The man was, to an extent which we need not determine, very clearly debarred from a free sale of his labor. The spirit and intent of the law as enunciated by our worthy judge were violated; but there was absolutely no legal evidence procurable and no remedy.

When it comes to that, I don't even believe that there was much guilt in the matter. It was the result of a lack of a definite perception of a better way. The proprietors of those concerns, who thus worked, as they supposed, with each other and against their workmen, were honest, honorable, liberal men, men for whom I had a regard which was full of respect and something more, men whom the whole community rightly prized, and many of whom have now closed their earthly records with no other flaw that I know of but this. In business, the competition of these men in the matter of procuring materials and supplies was constant and open. In the securing of contracts and in the selling of their goods there was no let-up in the keen pursuit, and every success of the one over the other was openly exulted in. Yet in the purchase of labor it was necessary "for self-defense" that there be no competition. What if there had been open competition? Wages might undoubtedly have ranged somewhat higher, and the workmen would so far have been benefited, while if all the employers had to pay the advance no one would have any advantage over the other any more than before. I believe in free trade in labor, if I don't believe in free trade anywhere else. I don't know any place where anybody has any right to interfere with or restrict it. If it is wrong, as it clearly seems to be, for an employer to interfere with the right of an employee to get work wherever he can, and to get all that he can for it, we seem to be compelled to say that it surely can't be right for one workman to prevent another workman from working for any man with whom he can make a mutually satisfactory arangement. No job belongs to anybody, that I know of, but to the one who has it, and while he has it. If he gives it up, I don't see how it is still his, and if somebody else wants it, and can get it for the asking, why shouldn't he take it? It is a most foolish thing, as it seems to me, for a fellow whose business in life it is to work for wages, to stand around and do nothing while there is work to do.

Men can think and men can talk between times without stopping work, and all that it is possible to adjust can be adjusted, and all the advantage that it is possible to gain can be secured by full discussions and broad and mutual understandings between the greatest of traders, the sellers and the buyers of labor.

TECUMSEH SWIFT.

Superintendent Wanted.

Editor American Machinist:

After reading the article "Superintendent Wanted," in your issue No. 43, the writer has wondered if, even though the next superintendent should be "someone who can run the place," will the directors give him full opportunity to prove that he is competent to do so?

Four superintendents in six months seems to indicate there is something else wanted at that shop, namely, a new board of directors. J. F. C.

Baltimore, Md.

Speeds for Grinding and Polishing Wheels.

Editor American Machinist:

The accompanying diagram is the same as the one that appeared in your issue No. 41, put in logarithmic form, so that, instead of curves, the reference lines are straight. In this way the angle formed by the intersection of the lines in tracing out a problem is always the same, and the degree of accuracy is also the same throughout the scale. Should it be desirable to have some other periphery speed, it is easy to draw another reference line. Suppose we wanted to lay out the line for water tool grinders, speed being two-thirds dry grinders, or 3,520 feet per minute. Divide 3,520 by 10 = 352. Follow the line for 352 revolutions per minute down to the line for a wheel whose circumference is 10 feet, or 38¼ inches diameter, and through the intersection draw a line parallel to the line for regular dry grinders. In a similar manner a line can be drawn for any other periphery speed.

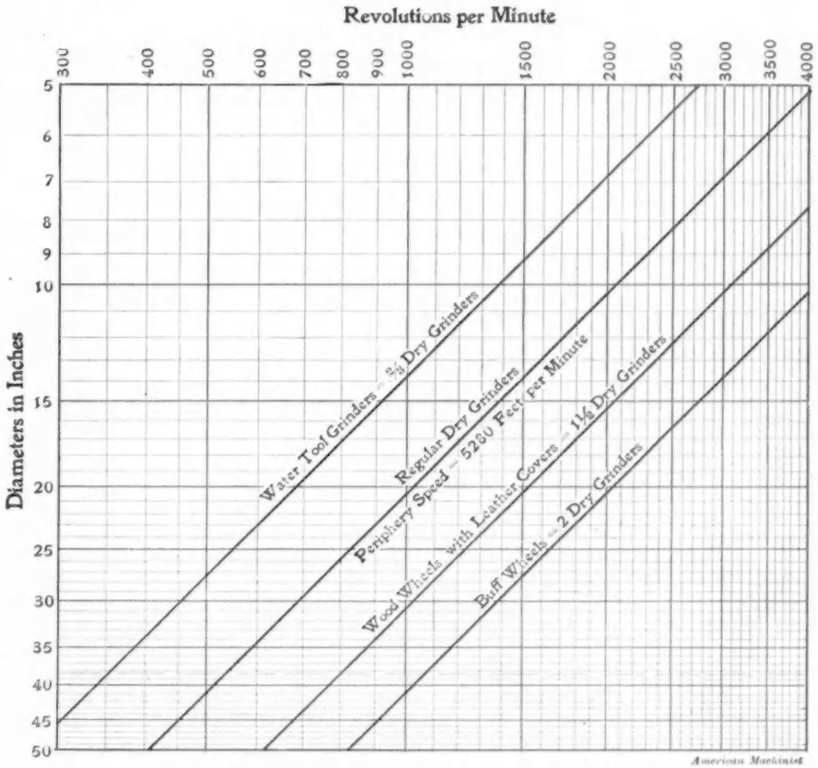


DIAGRAM FOR SPEEDS OF GRINDING AND POLISHING WHEELS.

F. W. SEIDENSTICKER.

Chicago, Ill.

[This is an excellent illustration of the saving of labor in laying out diagrams on logarithmic paper. Explanations of the properties and uses of this paper were given in our issues Nos. 25 and 26.—Ed.]

Rings and Ledges for Holding Babbitt in Cast Iron Boxes.

Editor American Machinist:

In No. 41 of the "American Machinist" "Hobo" describes a cheap and easy way of making certain kinds of core boxes. I do not suppose that this can really be called a new way, as I recall having seen similar ones over twenty-five years ago. It was not so much the core boxes, however, that I was thinking of—whether new or not—as the illustrating a ledge, as I take it to be, in the box to retain the Babbitt. Now, I would like to know what useful purpose these ledges serve. Some time ago an interesting article appeared in the "American Machinist" describing jigs, etc., for machining the castings of small horizontal engines, and among the operations performed, one was to bore the babbitting rings at the ends of the crank shaft boxes. In my innocence I had supposed that modern practice had abolished all such excrescences, and I was surprised to learn that an up-to-date concern was still using them.

Soon after I was shifted from the position of "jour" to that of foreman in our shop—and that was before the telephone

was thought of—a 2-inch shaft came to the shop for repairs. In fact, it was nearly cut through at one of its bearings by these babbitting rings. The babbitt chamber in the box was unnecessarily large, and of course the rings were pretty deep. The babbitt had worn completely out, so that the shaft bore on the iron bottom of the box; but the rings had apparently worn but very little, and consequently had nearly cut through the shaft. Before that I never had given the matter much thought. All the boxes I had ever seen were made that way, and of course "they had to *be* that way."

Well, after this practical demonstration of their usefulness, I removed the rings and ledges from all our patterns of ordinary sized boxes, encountering—in fitting up the castings—various cuss words from some of the men till they became accustomed to them; and I noticed that the next year the other shops in town were following suit.

When I proposed taking the rings out of a 9x21-inch pillow block for a gang (saw.nill men know what a "gang" is), the proprietor was inclined to call a halt, imagining that the excessive pounding such boxes received would squeeze the babbitt out if the rings were removed. We chanced to be making a gang at the time for a sawmill nearby, and I fitted the pillow block without the rings, agreeing to become personally responsible for its good behavior. The outcome was that we never used any babbitt rings or ledges after that in anything. That pillow block ran for ten or eleven seasons, to my knowledge, without renewing the babbitt; how much longer I do not know. And so I say I was surprised to find that the rings are still used by some.

"Hoodoo."

Government Manufacturing—Navy Yard Work.

Editor American Machinist:

In issue No. 43 you quote from the "Army and Navy Journal" an article by "Navy" on government manufacturing, which I think states the case very well, only he does not cover all the ground. One very bad feature of the system is that an officer is put in charge of each branch of work, which from the necessity of the case he is entirely ignorant of. It is foreign to his training, and, what makes matters worse, they are ordered to a navy yard for three years only, and then other officers take their places. As a matter of fact, the changes come much oftener, and in laying out plants and buying tools each has his whims which naturally spring from inexperience, but which make manufacturing very costly. Old Subscriber.

Portsmouth, N. H.

The Industries of New Zealand.

Editor American Machinist:

As an old reader of fifteen years' standing, I beg leave to correct some errors regarding New Zealand in your No. 28. For instance, one coal mine on the west coast has an average output of over 1,000 tons per day. There are something like twenty coal pits near Dunedin.

As to gold washing—this is the main industry in Otago, and every foundry in New Zealand is working two shifts, making what are called dredges. They have enough contracts on hand for the next three years. The general price runs from £5,000 to £7,000, or $25,000 to $35,000.

In respect to agricultural machinery, Mr. Bassett forgets that there is a Canadian firm that sends more out here than all the others put together.

There is no city lighted by electricity in New Zealand, neither is there any electric tramway. Auckland has just let the contracts for her system. Dunedin will shortly put a vote to the people to raise the money to equip an electric system.

We have a short line 1⅝ miles long that will be running in a few weeks in one of the suburbs. It is put in by Westinghouse.

As to engines, the majority of such on dredges are imported from England.

M. P. McKay.

Dunedin, New Zealand.

[After comparing the statements in the above letter with those quoted from Mr. Bassett in No. 28, we do not find that there are as many material inconsistencies as the letter might be taken to imply.—Ed.]

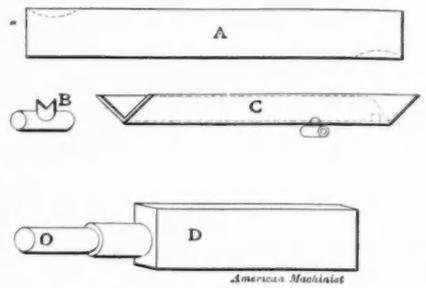
A Keyway Cutter.

Editor American Machinist:

Some time ago I had 2,000 shafts *A* to make of 1-inch cold rolled, 8 inches long, with a keyseat in each end. The milling machine was tied up at the time on a long job, and I set to work to devise a way to do the job quickly and well on another tool. The keyseats were of the "Woodruff" style.

I took a piece of 1½-inch angle steel, 2 feet long, and a ⅜-inch malleable-iron gas pipe "T." I filed the "T" as at *B*, fitted it to the under side of the angle steel, and brazed it fast, as at *C*. I then planed the inside of the angle steel so as to make it square and straight. Then I made a piece of machinery steel *D* to fit at one end in the tool-post of a 16-inch lathe, and at the other end turned to fit in the round hole in the "T" (the thread had been previously drilled out and the hole reamed). I then fitted a stop-pin inside the angle steel at the bottom of the angle and about ½ inch from the end. The next job was to put the cutter, ¼-inch face, 2 inches diameter, on an arbor with collars on each side, 1¼ inches diameter, and swing it on the centers. These washers acted as stops for depth of cut, which was to be ⅜ inch in the center of the cut.

The angle steel with its arbor was now mounted in the tool-post at right angles to the bed of the lathe, the carriage set to bring the center of the angle steel to the center of the cutter and then clamped solid. A shaft was then put in and the cross-slide set the proper distance from the center, then all the boy had to do was to bear down on the long end of the angle steel till the cutter would cut no more, then put in another shaft without stopping the lathe. After the lot was all done at one end another stop was put in the bottom of the inside of the angle steel at the proper distance from the first stop, and of such dimensions that the first keyseat fitted over it. The shafts being put in to



RIG FOR MILLING KEYSEATS IN SMALL SHAFTS.

fit over this second stop, it not only brought the keyseats on opposite sides of the shaft, as was intended, but also prevented the boy from cutting two keyseats on one end of the shaft; for unless the first keyway was over the second stop, the shaft would not bottom in the angle steel. By actual record the boy cut the 4,000 keyseats in ten days and four hours, and allowing the four hours for loafing, this made 1½ minutes to each keyway. This is almost quicker than they could be secured in a milling machine.

E. A. Suverkrop.

Foreign Postage Rates.

Editor American Machinist:

In issue No. 39 we notice an article on foreign rates of postage. As we are receiving fifty to seventy-five letters by every mail from the United States, and with each mail we have to pay from 25 to 50 cents deficiency of postage, we can sympathize with the Englishman who complained of Americans not paying the proper rates. We are continually pointing out these oversights to our friends, and in order to prevent their making these mistakes we frequently send them back the envelope, stamped as follows: "The postal rate to England is 5 cents for ½ ounce and 5 cents for each additional ½ ounce. Please see that letters to us are correctly stamped, otherwise we have to pay a fine of double postage."

We would like, however, to point out that you are not quite correct in regard to postages in England. Your article is correct so far as foreign postage goes, between the United States and England, but in England the ordinary letter postage is 1 penny, or 2 cents, for 4 ounces, and for

every additional 2 ounces ½ penny, or 1 cent.

We know that you always like to be correct in all of your statements, and it is evident the English friend who gave you the information was not up to date in the current rates.

CHARLES CHURCHILL & CO., LTD.
London.

[Since the article containing the error above referred to was written by an Englishman residing in London, we naturally accepted it as correct, without very critical examination.—Ed.]

System for Keeping Sets of Tools.

Editor American Machinist:

I have seen suggestions at different times in your valuable paper in regard to the arrangement of tool-rooms and methods for keeping tools so as to tell where they are and who has them in use if they are not in the tool-room. But I think they have the best system at the factory of the S. S. White Dental Company I have ever seen for keeping tools for manufacturing purposes. It is expensive at the start, but I think it soon pays for itself, from the fact that they make a great many small parts that are sold separately and are called for only as the stock in the different offices is sold out. In the first place, they have a catalog number for everything. That is kept in a book, and every operation is also numbered and has a letter. The different parts are lettered alphabetically, and the operations are numbered and also have a letter, like "252-A," which would be an operation on some part and is set down in the book. Now they have small boards that hold the tools for one, two or three of these operations, as the case may be. The tools are let into the board, and the board is lettered and numbered and kept in a drawer. These boards hold gages, taps, drills, reamers, counterbores and, in fact, all the tools pertaining to that job; so if a man knows what he wants to do, all he has to do is to go to the tool-room and call for the tools to do it, and if he doesn't, he can simply take the piece of work to the tool-room and they will give him the tools for it. The boards are arranged so that there are no empty spaces, and they can tell at a glance if the tools are all there, and also when they are taken back the man in the tool-room can as quickly tell if they are all there. They also keep their micrometers in the same way, with gages and wrenches. Their large tools are kept on shelves and are marked in a similar way; but all small tools, such as small jigs and tools to go with them, milling cutters and tools of that description are kept on these boards. They use paper letters and figures and stick them on and then shellac over the whole thing. Then they are given a coat of hard oil finish that keeps them in good shape and keeps the letters from being rubbed off in use. The drawers are cataloged in a similar way, so a man can turn right to any set of tools he wants at once; and if they are not there, the check of the man who has them out is, so it is known who has them. BARLOW.

The Combination Draftsman.

Editor American Machinist:

In his entertaining article, "The Convenient Draftsman," in issue No. 41, "Mac" shows us some of the interesting features of a draftsman's life. The machinist who can make a drawing, or the draftsman who is well acquainted with shop practice, is pretty apt to find as great a variety of work as he could wish wherever he is located. And if the shop is so small that but one draftsman is employed, the number of jobs that will crop up in the course of a week for that one man is amazing. Oftentimes it seems to make little difference whether a man hires out for office work or shop work, as his time may be pretty well divided between the two. I think that a situation of this class proves about as interesting and instructive as one could secure.

I went at one time a matter of several thousand miles to install a plant of machine tools, and found upon arrival that the shop was still several months from completion. As it was apparent that it would be some time before even a main line could be put up, at the suggestion of the management, I started work in a temporary office, designing special tools, for this firm not only bought American machinery, but also wanted jigs and fixtures designed on the American plan. The man who had charge of this work, and who was to superintend the whole plant, was a man of wide experience in European and American drawing rooms, though with a somewhat limited knowledge of shop practice. Up to this time the greater portion of my work had been the making and using of tools, rather than the designing of them. We were able to work together to advantage, and between the two of us matters were pretty well discussed, both from theoretical and practical standpoints, and I believe the results were satisfactory. Later on I had the pleasure of seeing these special tools put through the shop.

The next job I took I expected to do more or less drawing, and some weeks it *was* more and some weeks less. After getting some of the machinery in operation I was requested to lay out a job on the board. This was not completed before there was more machinery in the shop to be started, and this see-sawing between shop and office continued as long as I stayed at that place. This was most interesting and valuable experience, though often it seemed to me I did not make the headway with a job that I could have done had I been able to give it my undivided attention.

I thought that I had thus far been getting a varied experience, but the next firm I worked for gave me a still wider range of work; for they wanted a man on the road now and then who was a machinist and who could also make a shop drawing if necessary. Here was a place where shop and drawing-room experience proved very useful, and the two combined gave me opportunities of seeing much of interest and value on both sides of the Atlantic.

S. F. ARTHUR.

Premiums to Belgian Workmen for Suggestions.

Editor American Machinist:

We read in the "American Machinist" your article concerning prizes to employees. It will perhaps be interesting for you to know that we already have had the pleasure of dividing more than $100 since we introduced the system of prizes for suggestions, over one year—that is to say, since we read it was in use at the National Cash Register Company's shops.

Brussels, Belgium. H. BOLLINCKX.

Punching Cast Iron.

Editor American Machinist:

Did any reader ever hear of punching cast iron? I have, but only as a legend. Now, I wish to put ¼-inch holes in a web of 3-16 thick gray iron. The holes may be rough and a large clearance of punch in die can be allowed. Will it work? C. W.

"Hors Concours" at Paris.

Those who visited the Paris Exposition saw many exhibits on which were placards bearing the legend, "Membre de Jurie. Hors Concours," which, as everybody who inquired about it knew, meant that the exhibitor or someone connected with his business was a member of the Jury of Awards for that class, and consequently, according to the rules of the exhibition, the exhibit was "out of competition" for an award, the words having just that meaning, and in that connection, no other. Nevertheless, some exhibitors whose exhibits were for this reason "hors concours" have claimed that this is a distinct classification by itself, superior to any regular award, even a Grand Prix, "Beyond all competition," etc. We have had several requests to state the facts of the matter, and have asked some exhibitors making the claim referred to for their statement or understanding of it in detail, but without success. We take pleasure, therefore in printing below a letter from the Director of Machinery and Electricity for the United States Commission, who, as it happens, without our suggestion, takes this means of setting the matter at rest, which of course his letter undoubtedly does. It is as follows:

UNITED STATES COMMISSION TO THE PARIS EXPOSITION OF 1900.
Paris Offices, Nov. 1, 1900.

Editor American Machinist:

Having received a number of letters from United States exhibitors on the sub-

ject of the relative values of the awards at the International Exposition of 1900, I believe that some little misunderstanding may have arisen as to the application of the rule placing exhibits "hors concours" by reason of the member of a firm or the representative being a member of the International Jury. I take this opportunity of quoting as follows from Articles 88, 89 and 90 of the Official Rules and Regulations of the French Government as applying to the Paris Exposition of 1900:

"88. The awards to exhibitors in the contemparary exposition, and to the collaborators, will be issued in the form of diplomas, signed by the Minister of Commerce, Industry, Posts and Telegraphs and by the Commissioner General. They will be divided into the following classes: Diploma of Grand Prize (Grand Prix), Diploma of Gold Medal, Diploma of Silver Medal,, Diploma of Bronze Medal, Diploma of Honorable Mention.

"89. Exhibitors who have accepted the position of juror or substitute, shall be placed 'hors concours' as to awards. This rule will apply to any exhibiting company who may be represented on the jury by a manager, or by an agent of any rank who may be upon the permanent staff of the company. Public administrations may compete for awards, even when one of their officers has been appointed a juror.

"90. Exhibitors attached to the jury, either as associates or as experts, shall be 'hors concours' in the class in which they have acted."

You will note that exhibitors who receive "Grand Prix," gold medals, silver medals, bronze medals and honorable mention, all receive a proper diploma from the French Government showing the award which they received. The exhibitor placed "hors concours" by application of the rule does not receive any diploma whatever and is not considered as receiving an award. In the official records of awards granted by the International Jury, firms placed "hors concours" are printed at the beginning of the class lists.

Owing to the practice which has been maintained in Paris during all International Expositions to chose from among the most prominent manufacturers a competent expert to judge the products of the world, the position as a member of the jury has been greatly sought by Europeans, and the designation "hors concours" in the commercial world is considered by many to have a rank equal to "Grand Prix." This, however, is purely sentimental, as it is not founded upon a substantial basis, so far as the regulations of the Exposition are concerned.

F. E. DRAKE,
Director of Machinery and Electricity.

At the Baldwin Locomotive Works, on November 17, Frank Kelly, a machinist, while oiling a machine, was impaled by a rapidly reciprocating rod and died soon after.

The Automobile Club of America's First Annual Show.

The automobile show in Madison Square Garden, New York, November 3 to 10, was a decided success from every standpoint. All the best concerns were there, and the attendance indicated a very general interest among the public in the mechanical features of the automobiles.

To the engineer, perhaps the most interesting thing in the exhibits was the evidence of efforts to improve on the steam carriage. In this field the Locomobile Company of America, operating under the Stanley Brothers' patents, may be considered the pioneer. The first machines built by them had a diaphragm regulator on the burner, a water glass but no try-cocks, rather small tanks, and a very small and lightly-constructed engine. These machines formed the starting-point from which nearly all the steam carriages in America have been developed. They were too light for serious work, their fuel consumption was much greater than was claimed, and numerous unsatisfactory details compelled their makers, in the course of a few months, to replace the original with a more substantial and better equipped machine.

The present "Locomobile" has added check valves to retain the pressure if the water glass breaks, a water column with three try-cocks, a cross draught to prevent the fire from being extinguished by a following wind, an auxiliary hand-pump for the boiler, and has an engine about double as heavy as that first used. The tiller steering lever has been discarded for a side lever, and the underframe, instead of being trussed and braced with every effort to make it rigid, is now reasonably flexible, so that one wheel may be above or below the plane of the other three without racking the frame.

Although the steam carriage is so simple to control, it requires a good deal of attention on the road, and numerous devices have appeared to minimize this by making the various functions automatic. The water level in particular it is sought to maintain constant by floats or other devices acting on the by-pass valve from the pump. The Keene (N. H.) "Steamobile" Company, for instance, which exhibited for the first time at the show uses a float which acts on one or the other of two levers, an upper one opening the by-pass, and a lower one at minimum water which shuts off the burner. Among the other features of the "Steamobile" were a power pump, started and stopped by the driver, for the air, and an indicator for the water level in the tank.

Without exception, the newer companies at the show dispensed with the removable torch for starting the fire. Either gasoline, drawn through a valve into a cup under the vaporizing coils, or wood alcohol, is used for the preliminary heating. The preferred method is to locate the vaporizing coils over a small fixed burner, in the midst of or adjacent to the main burner, and to keep this burner alight all the time. Then it is necessary in starting only to heat the tube supplying this pilot burner; and the main burner can be cut off entirely for any length of time without loss of steam, the pilot burner holding the pressure but not causing it to blow off.

The automatic principle is most fully worked out in the Victor steam carriage, built by the Overman Automobile Company. Here not only are the water level and burner flame automatically regulated, but the air pressure is kept up by a little steam pump controlled by a diaphragm regulator. A similar pump injects an added water supply when the steam pressure rises too high, and either pump may be started by hand, if desired, independently of its automatic arrangement. The Victor carriage has an inspirator by which water may be drawn into the tank through a hose, and one or two other carriages are similarly equipped. A fusible plug is used on several machines, but that of the Victor admits steam to a valve which cuts off the gasoline from the burner.

Though the Victor is a highly ingenious machine, it remains to be seen whether it will prove easier to manage; and another concern, the Foster Automobile and Manufacturing Company, boldly goes to the other extreme, and discards all automatic devices of any sort save the check valves to the water glass. This company uses a pilot burner under the boiler, and the fire is regulated by hand, according to the steam pressure.

The most noteworthy machines among the gasoline carriages were unquestionably the two racers and the six-passenger touring car built by Panhard & Levassor, and loaned for the exhibition by Messrs. Bostwick, Bishop, and Lyman. These superb machines, representing the finest of their kind, were an effective object lesson for the public in the matter of form; while, as for the builders, it was significant how many recent American designs show the influence of European practice. This has been especially true as regards igniters and vaporizers; but at least three machines at the show carried the motor in front of the dash under a hood, one prominent firm has discarded altogether the reach rods between the axles, and the use of ribbed cooling coils for the jacket water is rapidly extending. A few machines had the body and machinery separated by springs, but the approved practice appeared to be to bolt the body to the frame which carried the motor, transmission gearing, etc., and to suspend the unit thus formed by springs on the axles.

There is a distinct tendency to increase the power and weight of touring machines, and side by side with this to develop a line of light runabouts for city and suburban use. The latter have motors of from 3 to 5 horse-power, and the former have about double that power.

The manufacturers of electric vehicles were well represented, and novelties both in heavy machines and in very light ones were shown. A twelve-passenger break and patrol and emergency wagons, on the one hand, and on the other a runabout with ten cells and weighing complete only 550 lbs., may be mentioned. The latter had a frame of the "Locomobile" style, and was chain-driven by a ¾ horse-power motor.

Andrew Carnegie to Endow a Technical School.

At a dinner given on November 15 to Mr. Carnegie and the trustees of the Carnegie Library by W. N. Frew, president of the board of directors, he announced that if the city of Pittsburgh would provide a site for a polytechnic school near the Carnegie Library, he would erect the school and endow it with $1,000,000 in 5 per cent. gold bonds giving a revenue of $50,000 a year. In speaking concerning the matter, Mr. Carnegie said, in part:

"I have given much attention to technical schools, both in Great Britain and the United States, during the past few years. The work now being done by the technical institutes in Boston and Worcester, the Drexel Institute in Philadelphia, the Pratt Institute in Brooklyn, the Armour Institute in Chicago, is most encouraging.

"In Great Britain the Keithley Institute and the Halifax Institute, which I visited in September last to distribute the prizes to the students, gave me quite a surprise; nearly one-half of the 1,100 students in the former, and fully one-half of the 1,400 in the latter, were young men and women who worked during the day, improving themselves in various studies pertaining to their crafts in the evening classes of these institutions. I told these students that this impressed me more than any other feature. It recalled an essay written by my grandfather to 'Corbett's Register,' which that great man pronounced the most valuable communication ever published in the 'Register.' It was entitled 'Handication versus Headication.' In that article my grandfather thanked God that in his youth he had learned to make and mend shoes.

"I believe that a first-class technical school, probably as large as that of Worcester, would develop latent talent around us to such extent as to surprise the most sanguine. If the City of Pittsburgh will furnish a site, which I hope will be of ample size for future extensions, I shall be delighted to provide the money for such a school, taking care to provide room for additions to the buildings, to meet the certain growth of Pittsburgh."

The ability of the trustees in their management of the Carnegie Institute was highly commended, and the school is to be included with the institute under the same management. Various questions, such as whether fees shall be charged, or whether the school shall be open to graduates of the Pittsburgh High School or otherwise, are to be decided by the management. The tone of Mr. Carnegie's address indicated that he would later increase his contribution to meet the developing needs of the institution.

The Junior Mechanical Engineers.

The first meeting of the season of the Junior Mechanical Engineers of New York City and vicinity was held on Tuesday evening, November 13, at the house of the society. The meeting was eminently successful, except in the matter of attendance. Those who did not attend were distinctly the losers. The attendance of juniors was probably not much less than at previous meetings, but not so many of the older members were present. Mr. John C. Wait, author of a standard work on the law of contracts, and an associate of the Corporation Counsel of the City of New York, spoke for an hour and a half upon his specialty, "The Laws of Construction Contracts." The lecture bristled with valuable practical information and was interesting from beginning to end to everyone present. There was no time left for the actual discussion of any of the matters touched upon, but half an hour or so was spent in asking questions, which Mr. Wait readily and clearly answered. There is to be a second lecture by Mr. Wait, which promises to be of still greater interest, and to succeed that is expected a paper by Cornelius Vanderbilt, upon his locomotive boiler.

The Naval Architects and Marine Engineers.

The eighth annual meeting of the Society of Naval Architects and Marine Engineers, which was held in this city, November 15 and 16, was one of unusual interest. One evidence of the estimation in which the proceedings of this society are held abroad was in the presence at the meetings of Lieut. Commander De Faranaud, of the French Navy; Lieut. Commander Von Rebeur Paschwitz, of the German Navy; Capt. Stohensnovitch, Imperial Russian Navy; Capt. Beher, Imperial Russian Navy, and Naval Constructors Tehernigvosky and Makedonsky, Imperial Russian Navy.

President Clement A. Griscom opened the meeting with an address dwelling on the money now being expended upon naval construction in this country, the improvements in design and construction and the increased interest in naval matters. F. Merriam Wheeler read a paper describing a capacity test of an air pump used in connection with surface condensers. A paper by W. D. Forbes was on "The Interchangeability of Units for Marine Work." Duplicate or interchangeable parts being concededly so valuable, it was argued that the principle could be advantageously extended to embrace larger units or complete apparatus. Naval Constructor Taylor's paper described the United States experimental model tank. Prof. A. H. Sabin read a paper on "The Composition and Classification of Paints and Varnishes;" Naval Constructor Woodward described "Tests of the Electric Plants of the Battleships Kearsarge and Kentucky," and Spencer Miller told of "The Coaling of the Massachusetts at Sea."

The morning session of the second day of the meeting was presided over by Charles H. Cramp, and two important papers were attentively listened to. Assistant Naval Constructor H. S. Gilmor described "Recent Improvements in Foreign Shipbuilding Plants," and George N. Dickie discussed the question "Can the American Shipbuilder Compete with the British and German Shipbuilders in the Production of the Largest Class of Ocean Passenger and Freight Steamships?" Among other things Mr. Dickie said:

"I have lately had to discuss with the chief surveyor at Lloyds certain departures, that we considered slight and in the line of improvement, from the rules as applied to two large freight twin-screw steamers we are now building. I have found that the skill of the experts at Lloyds, and the careful study of every proposition made to them, not only protects all parties, but insures a steady forward movement. I believe, however, that an American register of shipping that would be accepted by the shipowner and by the underwriters the world over, would be a great help to the American shipbuilder, as it would no doubt lend itself more readily to the tendencies of American design. This would bring about a closer adaptation of the material used to its place and function in the complete design. In this the steel manufacturer will likely take a share.

"We are on this point now abreast of the British builder, and, in methods of handling, ahead of most of them. In skill, I think the American naval architect is quite abreast of his British cousin, and if he has plenty of practice there need be no fear of keeping him in that position."

On the relative cost of labor in American and British shipyards, Mr. Dickie said:

"From combining what information I have been able to gather I find that on an average the steel work of construction costs in the British yards from £3 17s. to £4 per ton of material worked. This, I think, we can about equal in labor cost here. We employ the same class of men as they do. Our total labor cost is about 25 per cent. greater than theirs. As to what we may be able to do in regard to equalizing the cost of labor, I do not think it will be brought about by any attempt to equalize the rate of wages paid throughout the shipbuilding world.

"I hope that some of our younger shipbuilders may be able to devise a method whereby every part of a ship, both hull and machinery, will have a labor value

fixed for it that will not exceed what such a piece of labor costs elsewhere.

"I find that the marine engine and its boilers cost less in proportion to the hull in England than they do with us. On the whole, I think the British builder has an advantage over the American builder in the cost of material. This applies even to the wood used. As near as I can judge at the present time, there is 10 per cent. in cost of material in favor of the British shipbuilders."

The following papers presented at the afternoon session we can give only the titles of: "Recent Designs of Battleships and Cruisers of the United States Navy," by Chief Constructor Philip Hichborn; "A Comparison of the Contract Prices of Our Naval Vessels," by Harrison S. Taft; "Launch of a Cruiser," by James Dickie; "The Safety of Torpedo Boats at Sea and in Action Under Various Conditions," by Naval Constructor Lloyd Bankson, and "Classification of Rules," by Theodore Lucas.

The meeting closed with a banquet at Delmonico's at which about 150 members were present.

A Proposed Combination of Trade Unions.

Some move has been made to secure co-operation, if not an actual amalgamation, of all the trade organizations of metal workers, and a meeting looking to that end was held in Washington a short time ago which was attended by official representatives of the International Association of Machinists, International Brotherhood of Blacksmiths, International Brotherhood of Boilermakers and Iron Shipbuilders, Iron Molders' Union of North America, Patternmakers' League of North America, Allied Metal Mechanics' National Association, Metal Polishers' and Brass Workers' International Union, Metal Workers' International Union. It is stated that a conservative tone pervaded the delegates, but that they expressed themselves as believing that organization is the order of the day and that workmen as well as others must organize.

It is anounced by an officer of the machinists' organization that the 9½-hour day will be granted in most shops, some employers paying for 10 hours' work and others refusing to do so. It is also stated that the 9-hour day will go into effect May 18, and it is expected that all the organizations named above will help to secure it.

Value of Carnegie Securities.

It was reported this week that a share of Carnegie Company stock had been sold on the Pittsburgh Stock Exchange for $1,500, the par value being $1,000. This is understood to be the first quotation made on that stock in the open market and if taken as a basis it would set a value of $240,000,000 on the $160,000,000 capital stock of the company. Of this Mr. Carnegie owns a little more than half. Subsequently it has been explained that no stock was sold, but that a bid of $1,500 was made, which amounts to the same thing in indicating the minimum value of the stock, unless the bidder had been confident his offer would not be accepted. The bonds of the company—of which there are $160,000,000 par value, running 100 years at 5 per cent.—are said to have sold recently at 105 and 105¾. In view of the large premiums in these days fetched by high-class 5 per cent. bonds—even by the best of those of industrial concerns, such as the General Electric Company—it looks as if the public does not regard those of the Carnegie Company as the most heavily gilt-edged.

A Large Casting.

The biggest casting ever made by the E. P. Allis Company, of Milwaukee, weighing 110,000 pounds, was poured on November 14. It was the bed-plate of a triple-expansion blowing engine for the Carnegie Steel Company, its dimensions being: Length, 23 feet 10 inches; width, 9 feet 9½ inches, and depth in the center, 5 feet. The cylinders of the engines will be one 40-inch, one 78-inch and two 76-inch, with a stroke of 60 inches. The casting was molded in a pit from a pattern. The pouring, under the direction of Joseph Harrison, was a complete success. This casting is near the limit for transportation upon a single car, both for size and weight.

Legal Notes.

BY WM. MARSTON SEABURY.

AGREEMENTS THAT WERE NOT ALLOWED TO MODIFY A WRITTEN CONTRACT.

The case of Merritt against Peninsular Construction Company decided last June by the Court of Appeals of Maryland is one of unusual interest. The suit was instituted by William C. Merritt to recover from the Construction Company the value of labor and materials furnished by him under a written contract for the construction of the Queen Anne's Railroad and also for *extra* work and materials. The defence was that the plaintiff had failed to complete the work within the time specified in the contract. It was provided in the contract that all of said work was "to be done under the direction and inspection of the engineers of the Queen Anne's Railway Company appointed to superintend the same," and to the "full satisfaction and acceptance" of its chief engineer, in "strict conformity with such plans, drawings and specifications and instructions as shall from time to time be given by the chief engineer, as herein provided, for the direction and guidance of the contractor." To protect the company from charges on account of extra work it was provided in the contract that "no claim for extra work shall be allowed unless this work shall have been done in pursuance of a written order from the engineer and unless the claim be presented at the first settlement after the work was executed." The plaintiff did not contend that the extra work for which he sought to recover additional compensation was done in pursuance of a written order from the engineer, but he based his right to recover upon an oral agreement between himself and the president of the company made before the signing of the contract and immediately thereafter to the effect "that if any change was made in the plans of the work which entailed work in excess of the work called for by the contract," such excess should be paid for by the company. The written contract was entered into on September 11, 1895, and by October 1, 1896, the road was completed all but about four miles of track on the fourth section. In June, 1896, Merritt had an interview with a Mr. Bosley, who was connected with the defendant company, in which Bosley agreed that if Merritt would subscribe $10,800 to the loan then being raised to complete the road, the company would furnish him with the materials valued at about $17,700 with which to complete the fourth section. Relying on this promise, Merritt made the subscription and some time after, when the company refused to furnish the materials agreed upon with Bosley, Merritt abandoned the work and refused to complete it; for the reason that the company had failed to fulfil Bosley's agreement. Upon the trial of the action Merritt sought to prove the oral contract with the president, but the Court refused to allow him to do so on the ground that the oral contract, if proved, would alter the written contract, and that it was therefore inadmissible. Judgment was rendered in favor of the defendant, and the plaintiff appealed to the Court of Appeals, which court affirmed the judgment of the lower court and held that the verbal contract was not an independent agreement about which the written contract was silent, but that it was a modification of the written contract and could not therefore be proved; and further that the provisions of the written contract relating to extra work included all kinds of work, and that the lower court had acted properly in refusing to allow the oral contract to be proved. As to the agreement with Bosley, the Appellate Court held that to make it binding upon the company it must appear either that Bosley had power and authority to bind the company in such agreement or that the company subsequently ratified or adopted it. Failing to prove either of these essential facts, the oral agreements could not be considered as valid and must therefore be regarded as of no effect and the rights of the parties must be determined solely under the written contract. (46 A. R. 1013.)

NO ABSOLUTE DUTY TO COVER A CERTAIN MACHINE.

Benjamin V. Stafford, a boy of about nineteen years of age, while in the employ of the Lafayette Carpet Company, lost his left arm by falling into a machine used for the extracting of water from yarn. An action was brought by the boy's next friend in the Superior Court, Tippecanoe County, of Indiana, to recover damages for the injury mentioned, from the carpet company. Judgment was rendered in the plaintiff's favor for $1,650, from which the defendant appealed. The plaintiff contended that the defendant was negligent in having failed to give him any instruction as to the dangerous condition of the machine; that he was obliged to work in a narrow passageway in which it was difficult to see because of the density of steam. He also contended that under the revised statutes of Indiana the defendant was required to cover its machinery, which requirement it had neglected to observe. The plaintiff failed, however, to prove that he himself was ignorant of the fact that the machine was uncovered and that he was unaware of the danger of operating the machine, and he further failed to prove that the defendant knew his age or his inexperience. The Appellate Court reversed the judgment of the lower court and held that there was no absolute duty on the part of the defendant to cover the machine in question and that even if the statute requiring the defendant to cover its machinery was applicable in this particular case, as the statute did not go into effect until after the plaintiff had received his injuries, it could not be binding upon the defendant in this instance. (57 N. E. R. 944.)

Personal.

Our contributor, Baxter Aslakson, is now superintendent of the Stearns Automobile Company, Syracuse, N. Y.

R. H. Klauder, chief engineer of the construction department of the Electric Storage Battery Company, lectured before the Mechanical Engineers' Club of the University of Pennsylvania November 9. After describing the reasons for installing batteries in lighting and railway plants, and showing how the output of the batteries varied with the rate of discharge, views of many of the installations made by this company were thrown on the screen and the principal features of installation and control were explained.

Obituary.

Lyman Bickford, a pioneer manufacturer of agricultural implements, died, November 14, at Macedon, N. Y., eighty years old.

George L. Allen, of the firm of William Allen & Sons, builders of steam boilers, Worcester, Mass., died November 4, forty-seven years old.

Stephen Cox, founder and active manager of the firm of Cox & Sons, Bridgeton, N. J., makers of heating apparatus, died November 18, seventy-nine years old. He was born in Staffordshire, England, and came to this country at the age of 30. In 1866 he founded in Bridgeton the large foundry and machine plant which bears his name.

Martin Irons, once prominent as a labor leader, and who conducted the Missouri Pacific strike in 1886, died at Bruceville, Texas, November 17, sixty-eight years old. He was born in Scotland and came to this country in 1846. After the great strike he was reduced to poverty. He had a small fruit stand in St. Louis for a time, and later went to Texas a broken-down man.

William S. Reyburn, founder and head of the firm of Reyburn, Hunter & Co., lightning-rod manufacturers, died in Philadelphia November 14, eighty-one years old. He was at first a nurseryman, but early began making the lightning-rods in a blacksmith shop at New Carlisle, Pa., and he soon had agents in all the Eastern States and developed a large and profitable business.

Civil Service Examinations.

The United States Civil Service Commission, Washington, D. C., announces an examination to be held December 12-13, for assistant operator Ordnance Department, and on December 12-15, for ship draftsman.

Technical Publication.

"Treatise on Kinematics." By Privy Councillor Prof. Dr. F. Reuleux, Berlin. Second volume. "The Practical Relations of Kinematics to Geometry and Mechanics." 670 illustrations and 2 appended plates. Published by Friedr. Vieweg & Sons, Brunswick, Germany.

This work is a large octavo book of 777 pages, and is the most complete work on the subject yet published, containing, in fact, a closing chapter on the kinematics of the animal kingdom, which is a most interesting study. This book forms Volume II to the author's "Theory of Kinematics," published in 1875, and shows his great profundity in the study of the principles underlying mechanism and machines. The author in this treatise corrects many historical traditions in engineering, such as that of Archimedes' proposal of moving the earth with a lever, and the story of "Eureka," also relating to the famous engineer of antiquity. He points out that when Archimedes launched the 4,200-ton gallion, it was by means of one of his inventions, a worm, and not a lever; the translator was not an engineer, and hence used an incorrect term. Archimedes also determined the composition of an alloy, not from its loss of weight in water, but from the weights of the volumes of water which it and its equivalent weight of component metals displaced. The chapter describing how the Egyptians and Assyrians moved their collosal blocks of stone, obelisks and monuments is also very interesting. In the first chapters the cycloids are most fully treated, and simple methods by which they can be calculated

(*Continued on page 48.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Mfg.plants,space,powers,land. A.Ela,Boston.

Gear Wheels, gear cutting. Grant; see p. 22.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Machines constructed, detail drawings made for the trade. Address "Shop Experience," care AMERICAN MACHINIST.

Rust destroyer, guaranteed to eliminate rust; trial sample furnished upon application. L. Veil, East Pittsburgh, Pa.

Wanted—21 in. turret lathe, 60 in. vertical boring mill, 20 in. drill, No. 2 milling machine, 14 in. brass finishing lathe; must be cheap, good second-hand tools. Box 54, A. M.

Wanted—30 in. or 32 in. lathe, 20 ft. between centers; 3 ft. arm radial drill; ½ in. to 2 in. bolt cutter; keyseating machine; 5 ton hand-power traveling crane, about 20 ft. span. Address Box 55, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W. Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Practical mechanical draftsman wishes position in New York city. Box 63, AM. MACH.

First-class, experienced draftsman and designer; technical graduate. Box 77, AM. M.

Draftsman wants position; paper machinery preferred. Address 202 B, care A. MACH.

First-class draftsman, experienced, wishes position immediately. Address Box 82, A. M.

Mechanical draftsman of practical drawing-room experience wants permanent situation. R., care AMERICAN MACHINIST.

An experienced foreman on engines, air compressors, general machinery, desires position. Box 70, AMERICAN MACHINIST.

Mechanical draftsman wishes position; technical education; 4 years' experience. Address Box 69, AMERICAN MACHINIST.

A young practical mechanical engineer, with extensive experience, wishes position with large manufacturing company. Box 26, A. M.

A practical superintendent of an up-to-date machine shop wishes to make a change; 15 years' experience; 40 years old. Box 71, A. M.

Situation, by a first-class machinist; can take charge; up to date; 9 years' experience in modern shops. Address "Toolmaker," Box 416, New Britain, Conn.

(*Continued from page 47.*)

are shown, without the use of higher mathematics, bringing their use within the field of applicability of most engineers. The book, in its illustrations of principles, shows most of the recent devices and is replete with references to American devices, tools and machinery as well as its literature. The principles underlying all possible kinds of mechanism and their functions and operation are fully treated. It is to be hoped that this valuable work will soon find an English translator. The mechanical execution of the book is in keeping with the character of its contents.

In building a twenty-story structure in Philadelphia, after the steel skeleton was up, the erection or application of the external masonry was begun at the tenth story and carried upward while the stories below were still unenclosed.

Dr. Tolman's monograph, entitled, "Industrial Betterment," noticed at page 984, can be obtained by addressing Dr. Wm. H. Tolman, Room 608, 105 East Twenty-second street. New York.

A ball-bearing watch was shown at the Paris Exposition. It is a man's watch, of ordinary size. All the pivots roll on balls of ½ and ¼ millimeter diameer (.02 and .01 inch). The ends of the spindles are conical and the shoulders and sharp corners of the old bearings are avoided.

The Geo. F. Blake Manufacturing Company write us that they did not receive a gold medal at the Paris Exposition, as would be inferred from the inclusion of their name in our published list, but that they did receive the Grand Prize.

In the past fifty years the copper mines of Michigan have paid dividends amounting to over $100,000,000. For the decade ending in 1899 the dividends were $47,982,000, and the value of the product for the same period was $155,878,718.

It has been a disputed point whether aluminum is attacked by sea water. This seems to be pretty well answered by the injury to the aluminum plates of the yacht "Shamrock," which is noticed at her water line. Probably the plates will be changed.

It cannot be that the British Admiralty has yet abandoned the Belleville boiler, as it has recently ordered a set of eighteen boilers to be manufactured in Keyham Steam Factory—a government plant—for the cruiser "Encounter." They are to be capable of driving the engines at 12,000 horse-power. This is said to be the largest order for boilers ever given to a government shop.

Situations Wanted—Cont'd.

Expert designer of automatic paper cutters, with new and special devices, wants position in New York city. "Paper Cutter," care AMERICAN MACHINIST.

Young man, good hustler, desires position as foreman of machine shop; experienced in engine and heavy machine tool work; can furnish good references. Box 79, AMER. MACH.

Wanted—Position as superintendent or head foreman, by man with wide experience in modern shop management, good executive and inventive ability. Box 78, AMER. MACHINIST.

Wanted—Position as foreman in machine shop, by a thorough, practical mechanic; up to date in modern shop methods and can handle men successfully. Box 80, AM. MACH.

Technical graduate, 7 years' experience in shop and drafting room, wishes change; special machinery, gas engines, steam engines, conveying machinery. Box 68, AMER. MACH.

Assistant superintendent, technical graduate, 5 years' experience, desires change; references from present employers; Rochester, Buffalo or Cleveland preferred. B. R., AM. MACH.

Young man, age 25, experienced, practical draftsman, general mechanical ability, references, desires position as assistant to superintendent or mechanical engineer; vicinity New York. Box 81, AMERICAN MACHINIST.

Have held successively the positions of chief draftsman and designer, superintendent and general manager; owing to consolidation am open to engagement; references from former employer. Address Box 58, AM. MACH.

Position as pattern-shop foreman; well up in modern methods appertaining to economical shop management; have had 14 years' experience on engines, pumps and transmission machinery; good reference. Box 59, A. M.

Wetstone grinder and polisher, first-class workman on all kinds heavy and light machinery and engine work, desires position; can take charge polishing and plating plant, all classes iron, steel, brass. Box 72, AM. MACH.

Practical mechanic, experienced in interchangeable manufacturing, open for engagement; familiar with latest methods for reducing costs and expert designer of special tools and fixtures; superintendent or assistant on work similar to cash registers, typewriters, etc. Box 73, AMERICAN MACHINIST.

Superintendent wishes to make a change; would like to get into a good, up-to-date factory where ability rather than talk would be appreciated; have had 20 years' practical experience on automatic machinery, tools, punches and dies, both open and sub-press dies, on the interchangeable system; good organizer and disciplinarian; inventive abilities and designer; correspondence solicited from good, reliable firms. Address "Exactitude," care AMERICAN MACHINIST.

Help Wanted.

Wanted—First-class pattern makers. Baker Brothers, Toledo, O.

Wanted—An experienced cost-keeper; state experience and salary expected. Box 45, A. M.

Wanted—First-class pattern maker to take charge of pattern shop; must be a hustler. Address Box 564, Wilmington, Del.

Wanted—Two metal patternmakers. Apply to the Ohio Brass Company, Mansfield, Ohio, stating experience and wages wanted.

Wanted—First-class draftsmen familiar with steam hammer designs. Address Box 75, AMERICAN MACHINIST, with full particulars.

Wanted—Experienced draftsmen for punches and shears; state experience, age and salary expected. Address Box 76, AMER. MACHINIST.

Wanted—Designer on hand pumps, also expert to take charge of costs in machine shop and foundry. Box 66, AMERICAN MACHINIST.

Wanted—A first-class drop-hammer die sinker; steady work; good wages. United Shoe Machinery Co., McKay Dept.; Factory, Winchester, Mass.

Wanted—Three first-class mechanical draftsmen with considerable experience in designing detail electrical apparatus. Address Box 50, AMERICAN MACHINIST.

Wanted—Competent draftsmen experienced with large machine tool designing; give experience, references and salary expected. Address Box 74, AMERICAN MACHINIST.

Wanted—One good mold maker for general repair work on molds; steady work and good wages guaranteed; non-union man only need apply. Address H., care AMER. MACHINIST.

Wanted—At once, two competent men for general machine work, also two experienced men on embossing dies. Apply immediately, Greenwood Bros. & Co., Gardner, Mass., Sta. A.

Wanted—One tool and die maker on small work, also draftsman for working up details on small machinery; state age, experience and wages expected. Address "Massachusetts," care AMERICAN MACHINIST.

Wanted—A competent, business-like foreman, familiar with press and die work; must be good machinist. Address A. L. W., care AMERICAN MACHINIST, stating fully age, experience and compensation expected.

Wanted—Machine tool salesman; must be capable and energetic; a practical man or technical graduate preferred; a first-class position for the right man; give full particulars. Box 51, AMERICAN MACHINIST.

Wanted—First-class man as superintendent of brass foundry and machine shop; one thoroughly familiar with steam and electric railway work preferred; state age, reference, etc. "Machinery," care AMERICAN MACHINIST.

Wanted—Three good draftsmen, familiar with laying out pipe plans for ice and refrigerating plants; state experience, age and salary expected and also give references. Address Box 62, care AMERICAN MACHINIST.

Resident agent wanted in Philadelphia, Buffalo, Cleveland, Chicago and St. Louis, to push our transmission machinery and specialties; state experience and full particulars. Address "Transmission," care AMER. MACH.

Wanted—An expert shop cost accountant, to organize new system in foundry and machine shop; must come well recommended and have good record; state age and experience in application. Address "Gears," care AM. M.

Wanted—Mechanical draftsman for shop employing 250 men, on hydrants and valves, competent to design and make all drawings and prints required; state age, experience, references and wages expected. Box 64, A. M.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Mechanical draftsman, graduate engineer preferred, especially with experience in gas works construction; good opening for energetic young man; state experience and salary expected. The Western Gas Construction Co., Fort Wayne, Ind.

CLEVELAND GEAR WORKS
W. R. SAWYER, Lessee.
86 Seneca Street,
CLEVELAND, OHIO.
Gear Wheels and Gear Cutting
of all descriptions.
Get Our Prices.

AIR COMPRESSORS
Send for Complete Catalogue.
CLAYTON AIR COMPRESSOR WORKS,
25 Cortlandt Street, New York.

VANDERBEEK TOOL WORKS,
Hartford, Conn., U.S.A.
Universal Joints
run at 70° angle; solid stems, which can be turned or bored out close up to the ball circle; bearing contact on whole circumference; little friction; simple; strong.
PRICES: ¾ in. $1.50 each; 1 in. $2.00; 1¼ in. $2.50; 1½ in. $2.75; 1¾ in. $3.00; 2 in. $3.25; 2½ in. $6.75 f.o.b. Hartford.
Beware of Imitations.